THESIS ABSTRACT

Master of Public Health

Adventist University of Africa

School of Postgraduate Studies

Title: ASSESSMENT OF KNOWLEDGE, PERCEPTION, AND INFRASTRUCTURE AS DETERMINANTS OF WASTE MANAGEMENT PRACTICES AMONG SELECTED COMMUNITIES IN MONTSERRADO COUNTY, LIBERIA

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Date completed: May 2025

Waste management in Montserrado County, particularly Monrovia, remains a critical challenge despite regulatory efforts. Over 90% of waste is improperly disposed of, exacerbated by rapid urbanization, inadequate infrastructure, and gaps in public knowledge and perception regarding waste disposal risks. This study investigates the relationship between knowledge, perception, and infrastructure as determinants of waste management behavior.

The study aims to assess the influence of knowledge, perception, and infrastructure on waste management practices in Montserrado County. A quantitative, cross-sectional design was used, surveying 383 households in Monrovia (20.78%) and Paynesville (79.22%). Quota sampling ensured representation across socioeconomic groups.

Data were collected via structured questionnaires. The findings reveal that waste management knowledge and infrastructure have a significant relationship with and do influence residents' waste management practices, while perception does not have a statistically significant impact. The combination of knowledge, perception, and infrastructure shows a strong predictive relationship with waste management practices. These results highlight the critical role of education and infrastructure availability in promoting effective waste management behaviors. Strengthening infrastructure is key to improving waste management Practices. Authorities should invest in waste collection points, recycling facilities, and regular waste disposal schedules to enhance community participation and environmental sustainability.

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A thesis

presented in partial fulfillment

of the requirements for the degree

Master of Public Health

by

Amelia Joe Zayzay

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I dedicate this research to God, and my family.

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ACKNOWLEDGEMENTS

I extend my deepest gratitude to the Almighty God for His unfailing grace, wisdom, and providence throughout my academic and research journey. His divine guidance and abundant blessings have sustained me in countless ways, including the generous scholarships from the Adventist University of Africa (AUA) and the Adventist University of West Africa (AUWA), as well as the support of dedicated church members, and our compassionate Kenyan family.

I am profoundly thankful to the Adventist University of Africa community for their unwavering support. My heartfelt appreciation goes to my Primary Adviser, Erhuvwukorotu Kollie, PhD, for her invaluable guidance; my Program Director and Secondary Adviser, Janet Odhiambo, MPH, DrPH, for her insightful mentorship; and the Dean of the School of Postgraduate Studies, Lossan Bonde, PhD, for his leadership.

Finally, I express my deepest love and gratitude to my husband and children, whose unwavering support, patience, and sacrifices have been instrumental in this journey. Their belief in me has been my greatest source of strength.

CHAPTER 1

INTRODUCTION

The introductory chapter of a research project serves as the foundation upon which the entire study is built. This chapter presents the background, problem, significance, scope and limitation, and research questions and hypothesis. It also presents the study's theoretical framework and the contextual definition of the key terms in the research study.

Background of the Study

Waste refers to materials that have fulfilled their original purpose and are discarded by their producers (United Nations Statistics Division, 2018). It is a byproduct of nearly all human activities (Brunner & Rechberger, 2015). While the questions of what is waste seems direct, its classification is sometimes subjective, because what one person discards may be valuable to another (Doron & Jeffrey, 2018). This ambiguity presents a challenge for waste management, particularly in rapidly urbanizing and low-income regions.

Globally, municipal solid waste (MSW) exceeds two billion metric tons annually and is expected to increase by 70% by 2050 (Statista, 2023; UNEP, 2024). This surge stems from rising urban populations and intensified economic activity, especially in developing countries where waste infrastructure is often lacking. In 2020, global waste management costs reached $252 billion, projected to double by 2050 when hidden costs are considered (Statista, 2023). Unmanaged waste threatens

environmental sustainability and public health, demanding urgent governmental response.

Over 70% of waste in sub-Saharan Africa are throwaway in open areas that are not regulated. Among many things they cause air and water pollution (Ayeleru et al., 2020; Godfrey et al., 2019). Growth in population size, the movement of more people in the urban areas, coupled with weak regulatory systems have increased the waste management problem. Though it has direct connection with public health and the environment, waste management is frequently ignored in the development agendas of many countries (Jedwab et al., 2021; World Bank, 2018).

Knowledge, perception, and infrastructure are three intertwined major factors that shape waste management. Knowledge involves the ability of someone to sort, and safely disposal waste among others. But studies have shown that people's knowledge are not always reflected in their practice. In Ibadan, Nigeria, students had moderate awareness but still resorted to unsafe practices like open dumping, influenced by education, age, and gender (Adeolu et al., 2014). In Gokarneshwor, Kathmandu, despite high awareness (98.3%), only 41.7% adhered to proper practices due to demographic and socioeconomic factors (Sherpa & Pathak, 2019).

Infrastructure is equally important to waste management. In Gelemso, Ethiopia, 96% of residents acknowledged the dangers of improper disposal, yet 80% practiced it due to inadequate services (Eshete et al., 2023). Similarly, in Malaysia, although 95.9% understood the risks, only half segregated waste due to age, location, and residence type (Abdullah et al., 2017). Infrastructure, encompassing collection systems, recycling centers, and disposal facilities, determines whether intentions can become actions. Even informed populations struggle without it (Eshete et al., 2023).

Perception is the way individuals, households or communities view their responsibility and risk—also influences behavior. In Panji, Malaysia, awareness did not translate into action, with only 50.3% practicing segregation (Fadhullah et al., 2022). Positive perceptions, when supported by education and outreach, lead to greater participation (Onukogu et al., 2022).

Ultimately, sustainable waste management requires integrating education, perception-shaping, and infrastructure investment. Without addressing these simultaneously, long-term change remains unlikely.

Liberia as a country is not indifferent to the Waste management issues experienced worldwide among low-income countries, especially in Sub-Sahara countries. Like many other Sub-Saharan African countries, Liberia grapples with escalating waste production. As a low-income country, Liberia has experienced a notable population increase, particularly in urban areas. In 2008, the nation's population stood at 3,489,072, with Montserrado County hosting 1,144,806 residents, constituting 32.8% of the total population. Notably, 1,010,970 individuals (88.2%) were concentrated in the capital, Greater Monrovia, accounting for 28.97% of Liberia's populace at the time. Subsequent census data, fourteen years later, reaffirmed this trend, indicating further population growth. By 2022, Liberia's population had swelled to 5,250,187, marking a substantial 33.5% increase. Montserrado County's population surged from 1,144,806 in 2008 to 1,920,965 by 2022, reflecting a significant 40.4% rise.

Of the 1,920,965 individuals in Montserrado County, a staggering 1,643,936 (85.57%) reside in Greater Monrovia, accounting for 31.3% of the national population using the demarcation of the 2008 census. The 2022 census had more divisions. Monrovia, the Capital City has 161,891 (8.4% of Monterrado County) and

Paynesville City has a population of 617,492 (32% for Montserrado County). Liberia exemplifies the challenges outlined by Jedwab et al. (2021) and the World Bank (2018) regarding waste management and population growth in low-income countries. The statistics reveal a significant increase in the populations of Montserrado County and Monrovia. As noted by Jedwab et al. (2021) and the World Bank (2018), neglect of waste management is common in such contexts, despite the rapid pace of population growth and urbanization. This neglect results in over 90% of waste being disposed of in unregulated dumps.

In 2020 David Jr. et al. (2020) described how waste is managed in Liberia. They concluded in their research that there is a high increase in waste generation because of urbanization, with about 50.7% of the population living in urban areas. This pattern is common in Sub-Saharan countries. They observed that the increase in waste generation, which is at the result of urbanization, has resulted in several environmental problems, such as poor waste management infrastructure, and air population. In order to address these challenges, the Government of Liberia, in partnership with global institutions like the European Union, and the World Bank began several projects to address solid waste management, two of which are Emergency Monrovia Urban Sanitation Project and the Cheesemanburg Landfill Urban Sanitation. However, sustainable waste management remains a formidable challenge in Liberia.

They also observe that Liberia lacks a comprehensive waste management framework, coupled with a lack of guidelines for waste generators and insufficient commitment from decision-makers to implement a sustainable management system, exacerbates the deterioration of waste management activities in Liberia (David Jr. et

al., 2020). Public health and agriculture sectors in Liberia face severe threats from waste mismanagement, air pollution, and water contamination (UNEP, 2024)

Narrowing down to Monrovia, the capital city of Liberia which hosts the highest population of the country in urban areas, waste, which is produced by human and their activities, continues to be a challenge in Monrovia due to population increase and rapid urbanization (David Jr. et al., 2020). It brings along with it public health issues. In many communities in Liberia, waste is seen even on the main streets.

The researcher observed that people take their waste from their homes and place it on the main streets expecting the government to have it cleaned up. As it has also been observed by the researcher, wastes are taken from one community to another during the night hours by disadvantaged youth who are being paid by the waste generators. In the rainy season, the situation becomes worse the drainages are blocked by waste causing the waters to overflow into the streets and homes. These have been the practices over the years. These waste sites become the breeding places for mosquitoes and roaches that come back to the homes of residents and cause diseases.

These observations are confirmed by David et al. (2020) who find out in their studies that waste management in the city of Monrovia is characterized by large-scale illegal dumping and the burning of waste. There is ineffective door-to-door collection of waste and insufficient communal bins at designated locations which have resulted in the open dumping of waste in open spaces, street corners, and swamps. The Monrovia City Corporation who is responsible for managing solid waste within the city waste management services are rendered unsatisfactorily. Challenges to waste management in the city range from indiscriminate dumping due to the unavailability of communal bins, lack of treatment or recycling of wastes, lack of adequate technical

and technological skills, lack of specialized vehicles, and lack of public participation from communities. The study also revealed the absence of comprehensive waste recycling and reuse programs in the sampled sites. Their study, however, did not come up with the causes of the problem.

These routines concerning waste management in Liberia cause one to begin to ponder why no intentional actions are taken by community dwellers regarding these public health risks why do they continue to be a yearly circle? What could be their knowledge of waste management? Who do they think is responsible for the management of their waste? Do they link the influx of misquotes, roaches, and floodings in their homes because of their waste management practices? Could it be that the government has not put sufficient infrastructure in place to assist residents in rightly disposing of their wastes? The answers to these questions will provide causes to the Liberian waste management problem.

Statement of the Problem

Montserrado County, particularly Monrovia and Paynesville cities are facing a growing crisis of waste mismanagement that threatens public health and environmental integrity. Despite the existence of regulatory frameworks, large volumes of waste continue to be discarded in open and unregulated dumpsites. This ongoing problem raises questions about the underlying causes of ineffective waste disposal practices.

Preliminary observations suggest that limited public knowledge, unclear or indifferent perceptions about waste-related health and environmental risks, and inadequate infrastructure may be contributing factors. However, the extent to which these elements influence community behavior remains unclear. Understanding how knowledge, perception, and available infrastructure interact to shape waste

management practices is essential. Therefore, this study seeks to investigate these interrelated factors in selected communities within Montserrado County, with the goal of identifying barriers to effective waste management and informing more sustainable interventions.

Research Questions

1. What is the relationship between the level of knowledge of residents and their waste management practices?
2. What is the relationship between residents' perception of waste management and their waste management practices in Montserrado County?
3. What is the relationship between the availability and accessibility of waste management infrastructure and residents' waste management practices?
4. Is there a relationship between a combination of knowledge, perception, and infrastructure and residents' waste management practices?
5. Does the demographic profile moderate the relationship between the independent and dependent variables?

Hypothesis

$H0_1$: There is no significant relationship between the level of knowledge of residents and their waste management practices.

$H0_2$: Perception of residents does not influence their waste management practices.

$H0_3$: The accessibility of waste management infrastructure does not significantly influence residents' waste management practices.

$H0_4$: There is no relationship between a combination of knowledge, perception, and infrastructure of waste management and residents' waste management practices.

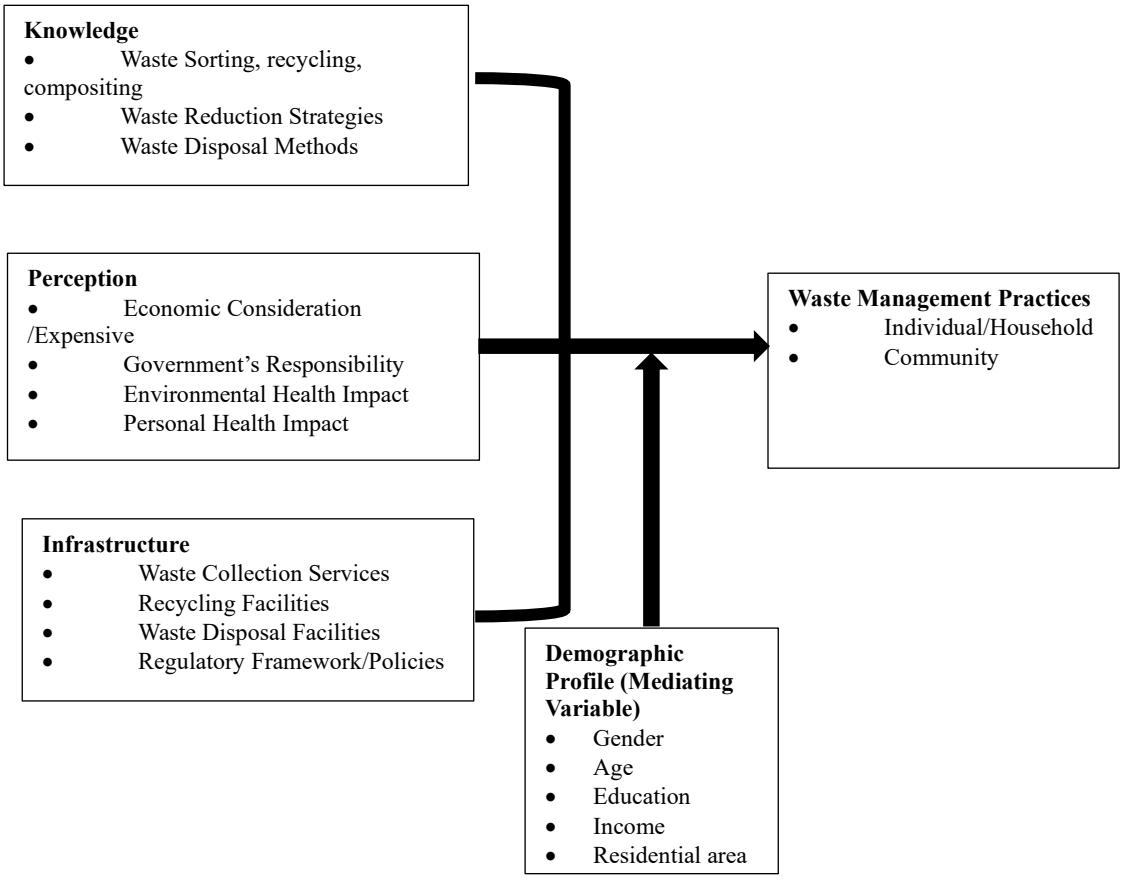
$H0_5$: The relationship between a combination of knowledge, perception, and infrastructure and residents' waste management practices is not significantly moderated by the resident's demography.

Conceptual Framework

Figure 1 shows that there are three independent variables, name knowledge, perception and instruction serving as determinants of the depended variable, waste management practices. The framework shows that residents' knowledge, perception, and infrastructure influence waste management practices at the individual, household, and community levels. It also shows that the demographic profiles of the residents, which are serving as the mediating variable, such as gender, age, and education can also influence the dependent variable by its relationship to the depended variables.

Figure 1.

Conceptual Framework



Significance of the Study

The significance of this study is seen in its attempt to address the reasons for the gap between knowledge, perceptions, infrastructural of residents and waste management practices in Montserrado County by using selected communities. The results provide useful information for public health workers, policy makers and cities authorities on how to plan waste management educational programs, and infrastructure for waste management for residents in various communities. Furthermore, the study will contribute to the academic discourse on waste management by providing context-specific data on Liberia, thereby filling a critical gap in both research and practice.

Given that Monrovia hosts over 80% of Montserrado County's population and accounts for more than 30% of Liberia's national population, any benefits derived from improved waste management in Monrovia are likely to have a broader national impact. The selected cross-section of communities in Monrovia and Paynesville provides a microcosm of the national situation, offering valuable insights for the National Public Health Institute of Liberia (NPHIL)—the government institution responsible for public health.

By identifying underlying factors such as limited public awareness, inadequate infrastructure, weak enforcement of regulations, and socio-cultural practices that contribute to current waste management challenges, the study equips community leaders and national policymakers with evidence-based data. This understanding will enable them to formulate informed, context-appropriate local policies that complement and strengthen national strategies for environmental protection and public health. The NPHIL, as the principal institutional beneficiary, can also utilize the study's findings for strategic planning and the development of future interventions aimed at improving waste management across Liberia.

Scope and Limitation of the Study

This study focuses on assessing the levels of knowledge, perceptions, and infrastructural factors influencing waste management practices in selected communities within Montserrado County, specifically Monrovia and Paynesville—the two most populated urban centers in Liberia. The research draws on a cross-section of communities reflecting diverse demographic and socioeconomic conditions.

To capture these variations, one high-density, low-income (slum) community and one low- or medium-density, high-income (affluent) community were selected from each city to ensure the inclusion of both urban and underprivileged contexts, as

well as educated and less-educated populations. For consistency and relevance, only households with a minimum of two occupants were included in the sample since that would mean a household and not just an individual.

Due to time constraints associated with completing a master's thesis, the study was limited to four communities in total. While these communities offer a meaningful representation of the broader waste management landscape in Monrovia and Paynesville, the findings may not fully capture all variations across the entire county. However, given the demographic significance of these two cities—together accounting for a substantial portion of the national population—the insights generated provide a strong basis for understanding the factors that influence waste management behaviors in urban Liberia.

Operational Definition of Variables and Measurements

Infrastructure: This refers to the availability of essential materials such as trash bins, waste collection trucks, designated disposal sites, and the existence of local laws and regulations governing waste management as provided by city or municipal authorities.

Knowledge: Is measured as the ability of the respondents to agree to correct statements about waste management or to disagree with false statements about waste management.

Perception: This pertains to respondents' views and attitudes toward waste management—its significance, cost, effectiveness, and opinions regarding whether responsibility should lie with government authorities, individuals, or households.

Waste Management Practices: These are the everyday actions people take to deal with their trash—like separating it, storing it properly, or disposing of it in a safe way.

CHAPTER 2

LITERATURE REVIEW

This chapter elaborates on the conceptual framework by detailing how each independent variable relates to the dependent variable. It discussed the dependent variable followed by an exploration of the three independent variables.

Waste Management

As humanity advances and creates innovative products to meet fundamental needs, the production and consumption of these resources lead to significant issues with waste generation and management across various regions worldwide (Ojewale, 2014). The United Nations Statistic Division (United Nations Statistics Division, 2018) define waste as materials that are not important products and the generator has no further use in terms of his/her purposes of production, transformation, or consumption, and of which he/she wants to dispose of.. Reducing pollution in the environment and improving land use efficiency are the main goals of waste management (Reddy & Lau, 2020).

Compared to wealthy nations, low-income countries place a much lower priority on waste management in this era of quickly rising population, urbanization and economic development. Although this may not be the case in large or capital cities, The World Bank (2018) shows that over 90% of waste produced is frequently disposed in unregulated dumps or openly burned in developing countries. Waste management is the various techniques and methods made and put into place to

regulate, recognize, and deal with the several types of waste from the time generation to disposal. A comprehensive waste management, including waste prevention, recycley, and reuse, can help prevent major environmental impacts when the life circle is examined which takes into account both direct effects like emissions and indirect effects like resource depletion (Mubaslat, 2021).

The processes of waste collection, transportation, processing, recycling, and disposal are all included in waste management. Maintaining environmental sustainability, public health, and general well-being all depend on efficient waste management (Qasim & Shareefdeen, 2022). As mentioned by Goyal and Gupta (2024), reusing and recycling materials while reducing environmental impact and promoting a circular economy are the goals of sustainable waste management techniques. Initiatives aimed at managing waste must include the public's involvement, awareness, and responsible consumption.

Waste Management Practices

The importance of waste management cannot be overstated. It assists in environmental sustainability, and the health of the public. According to Olawade et al. (2024), proper waste management involves the collection, transportation, recycling, and ultimately disposition of waste in an environmentally friendly manner. (Yukalang et al., 2017) observed that waste generation has risen globally considerably because of growth in population, and eating habits. According to the UNEP (2024), nearly 400 million tons of hazardous waste are generated globally every year. In 2018, the World Bank reported that more than 90% of waste is disposed of in open dumpsites or burned in the open air in low-income nations. Waste management practices is explained in detail in the under the following sub headings:

Waste hierarchy. It is the application of the most environmentally friendly and sustainable approaches in waste management. This concept is typically presented in the form of a pyramid, with the most preferred options at the top and the least preferred at the base (Kurniawan et al., 2022). It is applied in decision-making as to what should best approaches to waste management. For example, prevention becomes the most ideal approach since it is aimed at avoiding or reducing waste generation in the first (Kurniawan et al., 2022).

This is followed by reuse. The second step is to find means of reusing materials to further increase their lifespan. This is through refurbishing, repairing, or remodifying products rather than disposing of them (Goh et al., 2022; Mahartin, 2023). Glass bottles, PET bottles, clothes, papers, cardboard, leather, food scraps, metals, and anything else that can be utilized for an identical purpose to the original one are examples of solid wastes that can be recycled (Ugwu et al., 2021).

Waste to energy procedure. Utilizing a variety of techniques, such as, combustion/incineration, anaerobic digestion, gasification, and pyrolysis, energy recovery from solid waste converts waste materials into other significant and highly beneficial forms (Ugwu et al., 2021). Among these are fuel, electricity, and usable heat. Gasification is the process of converting carbonaceous materials into gaseous products by heat and chemical means at temperatures as high as 700 °C while using a gasification agent (Seo et al., 2018). Waste that cannot be recycled is turned into heat or electricity using Waste-To-Energy technology. Although it can be a useful method for handling some waste kinds, issues with air pollution and greenhouse gas emissions must be resolved (Chen, 2018).

Recovery/energy recovery. If prevention, reuse, and recycling are not feasible, the next step is recovering energy from the waste through incineration or

anaerobic digestion (Cucina, 2023). While not as environmentally friendly as the previous options, energy recovery can help reduce the reliance on fossil fuels (Taylor et al., 2024).

Disposal. The least preferred option is disposal, which involves sending waste to landfills or incineration without energy recovery (Richter, 2019). Landfills contribute to environmental pollution and resource depletion, so efforts should be made to minimize the amount of waste sent to landfills (Azimov et al., 2024).

Individual, Household, and Community Waste Management Practices

Waste management operation is not limited to one level. It can cross across several interconnected levels: individual, household, and community. The waste management practices at the level of household are shaped by the behaviors and practices of individuals within the household. Similarly, community waste management is influenced by the collective practices of the households that comprise the community and the government institution responsible for waste management. Thus, effective waste management at the community level depends on the participation and cooperation of households, which in turn are driven by the waste management habits of individuals.

For Example, HDFC Bank (n.d.) reports that India generates over 60 million tonnes of garbage daily, with 75% remaining untreated and ending up in landfills. Urban areas contribute more significantly to this problem than rural regions. They believe that the solution begins at home. By practicing effective waste management at the individual and household levels, people can reduce the overall waste that ends up in landfills. Simple practices such as segregating waste, composting organic matter, and recycling can make a significant difference. That means waste management

becomes effective or ineffective at the household and community levels depending on the individual's waste management practices. Though it is difficult to categorically find literature or research on individual, household, or community waste management separately, few will be cited.

Individual. Brotosusilo et al. (2020) argue that effective waste management programs at both community and governmental levels are impossible without active household participation. HDFC (n.d.) provides practical guidance for individual waste management at home, focusing on sustainability and environmental preservation. Key recommendations include:

1. Limiting Plastic Use: Reduce plastic consumption to mitigate environmental and wildlife harm by avoiding plastic bottles, straws, and cups, and using alternatives like cloth bags or repurposing old clothing.
2. Waste Segregation: Properly segregate waste into degradable and non-degradable materials to enhance recycling and cleanliness. Composting food scraps is also encouraged to minimize waste.
3. Reducing Paper Usage: Use digital solutions and substitute cloth rags for paper towels to reduce paper waste.
4. Composting: Compost organic waste to lower waste output and produce natural fertilizer.
5. Meal Planning: Plan meals carefully to reduce food waste by preparing only necessary quantities.
6. Buying guarantee clothing: Buying durable clothing that will last longer. These clothes could be given to others instead discarding them when they have outlived their usefulness in the owner's estimation.

Household. Proper waste management is not limited to what an individual does. It extends to the household and community-levels. Studies has shown that household wastes, which includes plastic, broken glasses, rotten food, are make up a significant component of municipal waste (Fadhullah et al., 2022). It has been observed that because of income, education levels, family sizes and location, waste produced by household makeup the largest amount of solid waste generated in cities.

To address these challenges, waste management programs must be tailored to specific community needs, supported by infrastructure investments, public education, and strong policy enforcement. Partnerships between government, private sector, and NGOs can drive innovative waste solutions, enhancing efficiency and reducing both environmental and health risks.

Community. In this study, the term "community" refers to the collective of individual households. Thus, community waste is essentially an accumulation of waste generated by each household. Community waste management may pertain to practices in specific neighborhoods, fenced properties, or broader community sections. However, in practice, waste is generally not managed at the community level, as there are no established community-based organizations overseeing waste management. Instead, waste management responsibilities primarily fall to government entities and certain NGOs. From personal observation of the researcher, the highest levels the community dweller can reach in waste management is to bring their wastes at the designated place or pay people to do so for them.

In Monrovia, waste management at the municipal or community level is led by entities like the Monrovia City Corporation (MCC) and the Paynesville City Corporation (PCC), often in partnership with NGOs. MCC's Solid Waste Management Department aims to create a clean, healthy Monrovia by promoting responsible waste collection, processing, and disposal to enhance residents' quality of life. The department's primary functions include:

1. Ensuring timely collection of solid waste through a well-managed primary collection system.
2. Transferring collected waste to designated processing and disposal sites using an efficient secondary system, which includes transfer operations and station management.

3. Processing waste through sorting, composting, incineration, and other sustainable methods.
4. Properly disposing of waste by managing dumpsites effectively.
5. Collaborating with the Community Service Department to raise awareness on solid waste management practices (Monrovia City Corporation, n.d.).

Despite these efforts, Monrovia has faced ongoing challenges in waste management. A substantial portion of household waste remains uncollected, and illegal dumping by individuals and industries continues in open spaces, on streets, and in swamps, posing severe public health risks (David Jr. et al., 2020). In 2019, the Environmental Protection Agency noted that Monrovia's solid waste management issues were compounded by low public awareness, inadequate environmental education, insufficient coordination among stakeholders, and limited community engagement. Additionally, there were deficiencies in resources, legislative support, and enforcement of waste management policies.

Monrovia's rapid urbanization, population growth, and shifting consumption patterns have led to a significant increase in waste generation. This challenge is further exacerbated by limited technological, financial, and human resource capacities. Research has found that Monrovia's waste management is marked by frequent illegal dumping and open burning of waste. Collection services, scheduled twice weekly, are often inconsistent, and door-to-door collection efforts are ineffective. The city also lacks sufficient communal bins in key locations, contributing to the persistence of improper waste disposal practices (David Jr. et al., 2016).Effective waste management practices are crucial for environmental sustainability, public health, and overall well-being. With global waste output escalating due to population growth and economic expansion, the need for efficient and ecologically friendly waste collection, transportation, processing, recycling, and

disposal has become more critical than ever. Previously, it was stated that waste hierarchy is concern with reducing, reusing, and recycling waste in order to provide sustainable waste management. Waste disposal is the final option.

Demography and waste management. The influence of the demographic factors on waste management practices has been one of the objectives of this study. Below are few studies on how demographic factors impact waste management practices. In Imo State, Nigeria, a study by Emesowum and Chiejina (2023) revealed significant associations between socio-demographic variables—such as age, education, occupation, and marital status—and the perception of respondents. The study revealed that over 72%) of the responded said that their waste disposal practices were influenced by the proximity of dump sites. This shows the importance of infrastructure in waste management.

Chikowore (2020) conducted similar research in Chitungwiza, Zimbabwe. The results revealed that household waste management practices were affected by socio-demographic factors of residents. The study found a strong relationship between the levels of income and the types of waste containers used as well as between gender and the willingness to pay for waste collection services. Over 55% of those in the age range of 25 to 44 were responsible for managing generated in homes.

In their study of the knowledge, attitututes, and practices of women in Tamil Nadu, India, Geetha and Rajalakshmi (2022), found that there was a correlation between between age, occupation, and income. In the same vine, Yahya et al. (2022), found that the occupation of the respondents was the most significant demographic factor affecting their disposal of e-waste, with private sector employees exhibiting the highest engagement in various disposal practices in Kuala Lumpur, Malaysia.

These studies support the assertion that demographic profiles play a vital role in moderating the relationship between waste management infrastructure and residents' disposal practices.

Knowledge

Now that we have provided an overview of waste management, we will now begin to consider the determinants waste management practices starting with knowledge. A strong foundation in knowledge is essential to comprehending the environment and the issues it presents. According to Schwartz (2016), knowledge is comprised of facts, information, and skills that are gained via education or experience. Knowledge has the power to alter perceptions, attitudes, values, and social norms regarding a welcoming environment. While attitudes refer to the adoption of positive values and concern for the environment, knowledge relates to a positive attitude toward waste management (Momoh & Oladebeye, 2010).

People’s perceptions toward waste management systems may be influenced by their level of waste management knowledge. Their view of environmental risks, such as floods and the spread of diseases, is influenced by their knowledge, which also affects their acceptance and confidence in SWM authorities. How much one trusts the organizations and authorities in charge of handling solid waste is reflected in their perception of risk (Ormerod & Scott, 2013). According to Hamer (2003), one of the main elements influencing public acceptance of solid waste disposal and management is the level of trust that the public has in SWM authorities. Hence, to raise residents' knowledge and awareness, the local government must conduct effective public outreach.

Increasing public participation and involvement in SWM projects is crucial for raising awareness. Ibrahim and Babayemi (2010) and De Feo & De Gisi (2010) also

stress that educating and motivating citizens to participate in SWM processes is a more cost-effective and efficient approach to lowering household waste. Sociodemographic factors including age, gender, occupation, education, and resident status can all have an impact on how knowledgeable people are about SWM and, ultimately, how they behave.

Due to unfavorable attitudes toward waste management, a lack of awareness and education makes solid waste management in developing nations ineffective (McAllister, 2015). For example, in Ghana, Addo et al. (2017) observed that residents blame the government for improper waste management because of the lack of awareness and education about waste management. According to McAllister (2015), a lack of passion for environmental issues results in little involvement in crucial procedures that have the power to change society and make it more responsible for SWM.

Several studies have explored the relationship between residents' knowledge and their waste management practices and found there is a relationship between knowledge of waste management and waste management practices. Below are few of these studies.

A study conducted in Ban Khlong Phai, Thailand, assessed the knowledge and behaviors related to household waste management among residents. The results indicated that participants had a low level of knowledge (mean score = 5.23, S.D. = 0.80) but exhibited moderate waste management behaviors (mean score = 1.37, S.D. = 0.37). Importantly, the study found a significant association between knowledge and waste management behaviors ($r = 0.16$, 95% CI 0.047 to 0.279, $p < 0.05$), suggesting that increased knowledge correlates with improved waste management practices (Prathumyo et al., 2023).

In a study assessing healthcare staff's knowledge, attitude, and practice regarding biomedical waste management, a Pearson correlation coefficient of $r = 0.456$ with a significance level of $p < 0.001$ was reported. This indicates a statistically significant positive correlation between knowledge and practice, suggesting that as healthcare workers' knowledge about biomedical waste management increases, their adherence to proper waste management practices also improves (Pravinraj et al., 2023).

Another study focusing on healthcare staff's knowledge, attitude, and practice about biomedical waste management found a very strong positive relationship between knowledge and practice, with a Pearson correlation coefficient of $r = 0.725$ and $p = 0.000$. This further emphasizes the critical role of knowledge in influencing effective waste management behaviors among healthcare professionals. In the context of municipal solid waste management, a study revealed a positive correlation between knowledge and practices. The results shows that participants with more knowledge on municipal solid waste management demonstrated better waste management practices (Laor et al., 2018).

Sahlabadi et al. (2024) , in a study of the relationship between environmental knowledge, education, and participation in environmental activities, and waste management practices of university students showed that environmental knowledge was a predictor of waste management practices. This suggests that students' knowledge levels through education leads to better waste management practices.

An investigation of the knowledge, attitude, and practice of households toward the management of municipal solid waste in Darmian city, South Khorasan, Iran, revealed that individuals with higher knowledge had better waste management

practices. This shows the importance of knowledge in establishing good waste disposal behavior at the household level (Ridayani et al., 2008).

Kamweru (2019) did a study on the knowledge, attitudes, and practices of households concerning solid waste management in Nakuru Town, Kenya. He found out those respondents who possessed relatively satisfactory knowledge and attitudes, still had poor waste management practices. This difference shows that knowledge may not be the only determinant of proper waste management practices; other determinants do contribute.

Lastly, a study focusing on the Gokarneshwor community in Nepal by Sherpa and Pathak (2019) assessing residents' knowledge and practices regarding waste management, found that although most over 98% of the respondents had a moderate level of knowledge, only 41.7% put their knowledge into practice. The study showed that there was no significant relationship between knowledge and practice.

Collectively, these findings from these studies show that while knowledge is a key factor influencing waste management practices, it is not the only determinant. There are other factors that affect waste management practices.

A study conducted in secondary school communities in Ibadan revealed that the level of knowledge, attitude, and practice of waste management was relatively moderate. However, the percentage of individuals using indiscriminate solid waste disposal methods, such as open dumping and burning, was higher. The study found that lower knowledge levels correlated with poorer waste management practices. Factors such as educational status, age, and gender significantly influenced waste management behaviors in these schools. Moreover, significant relationships were observed between students’ sex, age, and class and their level of awareness, knowledge, and waste management practices. The study concluded that understanding

the current status of waste disposal options and levels of awareness would help the government and other stakeholders establish effective environmental education and awareness programs on waste management (Adeolu et al., 2014).

A study conducted in Gokarneshwor, Nepal, assessed community knowledge and practice regarding waste management. Among the participants, 23.33% were illiterate, and half were engaged in household work. While 86.70% of respondents defined waste as unwanted or unusable materials, 98.30% demonstrated moderate knowledge of waste management. However, only 41.70% had good waste management practices. The study found no significant association between knowledge and practice, suggesting that awareness alone does not necessarily lead to proper waste disposal. Additionally, demographic factors such as gender, education level, income, and occupation played a mediating role in waste management practices (Sherpa & Pathak, 2019).

In Ethiopia, a study was made in a town called Gelemso on household knowledge, attitudes, and practices concerning solid waste management. Almost all the households (96%) believed solid waste to be an environmental pollutant. Out of that number, 92% agreed that they could be decomposed and 87.4% acknowledged the risks associated with improper waste management. However, 80% of households still engaged in dumping waste in waysides, backyards, or gullies and burning of waste, which are all improper way of managing waste. These challenges contributed to the disconnect between knowledge and practice, emphasizing the need for training on waste sorting, infrastructure development, and policy reforms to enhance waste management regulations (Eshete et al., 2023).

Similarly, a study conducted in Panji, Kota Bharu, Malaysia, investigated household waste management practices and perceptions. Using stratified random

sampling, researchers surveyed 338 households. Findings indicated that 74.3% of households disposed of food waste, while 18.3% disposed of plastic materials. Although 95.9% of respondents recognized the health risks of improper waste management, only half of the households practiced waste segregation. Statistical tests revealed significant associations between locality, age, and house type with waste segregation behaviors. The study emphasized the need for targeted waste separation programs to promote sustainable waste management practices (Fadhullah et al., 2022).

Both studies on school communities and general households show a gap between knowledge and practice in waste management. In Ibadan, students with lower knowledge exhibited poorer waste disposal behaviors, while in Gokarneshwor, the majority had moderate knowledge but poor waste management practices. Similarly, in Gelemso town and Panji, high awareness of environmental risks did not translate into effective waste disposal habits. These findings suggest that knowledge alone is insufficient to drive behavioral change. Instead, structured intervention programs, including waste management education, training on practical waste disposal methods, and improved infrastructure, are necessary to bridge this gap.

Across various contexts, from secondary school communities to general households, waste management knowledge is generally present but does not always lead to improved practices. The studies reviews the importance of integrating education with practical interventions, such as waste sorting training, community-based awareness campaigns, and investment in waste management infrastructure. To ensure a sustainable waste management system, governments and local authorities must implement policies that link awareness with action, fostering both behavioral change and systemic improvements in waste management services.

For waste to be well managed, individuals, households, and communities need the below knowledge. In order words, they need to be aware of the following about waste

Waste Segregation

As part of the waste management process, segregation at source entails dividing various waste materials at the time when of creation, which is usually in homes, businesses, or other establishments (Nelles et al., 2023). As indicated by Alawa et al. (2022), facilitating the effective and ecologically responsible handling, reusing, and discarding of waste is the main objective of segregation at source. When people and businesses separate waste at the source into groups, helps simplifies the recycling process and ensures that each type of waste is managed appropriately (Aprilia et al., 2010). Reducing the quantity of waste dumped in landfills is possible by separating waste at the source, which also makes it easier to recycle materials like paper, plastic, glass, and metal (Alawa et al., 2022).

Nevertheless, waste segregation comes with several challenges. Firstly, not many know the relevance of waste segregation and how it affects their environment. According to Fadhullah et al. (2022), poor knowledge contributes to inadequate segregation and disposal practices even when infrastructure is in place. Secondly, some communities do not have policies on waste management. As such there are no penalties for people who do not manage their waste well (Camarillo & Bellotindos, 2021).

Finance is needed to operate a good waste segregation system since infrastructure are needed (Aparcana, 2017). Addition to Xiao et al. (2017). Addressing these challenges through targeted education, infrastructure investment, and

community involvement can lead to successful waste segregation programs – which will be discussed in another section.

Recycling

Knowledge of waste segregation as seen above naturally leads to recycling since the waste to be recycled is already separate. Recycling means transforming waste materials into new products. This level emphasizes the importance of recycling materials like glass, metal, paper, and plastics to reduce the demand for raw materials and decrease environmental impact (Mahartin, 2023; Naor, 2023). Wastes stop being wastes and instead become valuable resources when they are recycled or treated. Glasses and metal wastes, for example, can be melted down to create various useful metal and glass products. Paper wastes can be recycled into new paper products that can be used for various uses, such as printing, tissue paper, cardboard, etc. (Ugwu et al., 2021). Ifeoluwa (2019) asserts that composting and all waste-to-energy procedures are the main components of recycling processes.

Concerning waste management, the information above proves that having knowledge on recycling helps individuals, households, and communities transform their waste items into usable items thereby reducing the need for new materials and lessening environmental impact. Wastes are converted into valuable resources, allowing materials like glass, metal, and paper to be reused in manufacturing. For instance, glass and metal can be melted down and repurposed, while paper can be recycled into new paper products.

Composting

The process of composting is the biological breakdown of mixed wastes by a mixed microbial population, resulting in materials that resemble humus and are called compost. It is a method or technique used to recover or transform wastes, primarily

organic, into other extremely beneficial uses (Pathak et al., 2021). It essentially entails the transformation of organic wastes, such as food wastes, leaves, sludge, fruits, animal waste, etc. by microorganisms into soil humus (González-Sánchez et al., 2023). Composting transforms organic waste into nutrient-rich humus, effectively recovering and repurposing waste into valuable soil amendments for agriculture. This process reduces landfill waste and enhances soil health, contributing to sustainable waste management practices.

Waste Reduction Strategies

Waste cannot be managed in its absence. Knowing how to avoid creating waste or reducing its production in the first place is not just important but may be the best way to manage waste. Appropriate practices, instruments, technologies, and infrastructure are needed to achieve a sustainable waste management system (Ugwu et al., 2020).

Mariyam et al. (2024) mentioned few waste management techniques, such as composting, recycling and resource recovery, and systems for disposal and treatment. They added that some management strategies, such as composting, reuse, and trash recovery/recycling, are currently carried out by the unorganized sector. By recovering, converting, and reusing valuable resources like plastic, polythene, paper, organic waste, etc., the recovery/recycling process boosts the economy. By drastically lowering the amount of solid waste dumped in landfills, these techniques prolong the landfill's lifespan, lower the number of harmful emissions from those facilities, and save the authority a respectable sum of money.

The process of composting organic wastes results in composts, which are used as nutrients for soil enrichment to support reforestation efforts and the maintenance of green spaces on campus and in the surrounding community (Dirks, 2021).

Furthermore, under carefully regulated humidity, and temperature, the anaerobic digestion of the organic component generates a sizable amount of methane gas that can be used to generate electricity or energy for campus use, either in conjunction with a wastewater treatment plant or on its own. Animals can also be fed food waste (Ugwu et al., 2021). The application of correct technologies is a necessary component of solid waste utilization and reduction approaches in order to create an optimal, sustainable system free from pollution and contamination. By using these methods, pollution of the air and water is reduced, jobs are created, and resources are saved for later use. Recycled and reused wastes need to be gathered at the source in distinct containers to prevent contamination (Mariyam et al., 2024).

Waste Disposal Methods

The last aspect of knowledge we want to discuss is the disposal methods of waste. Waste disposal methods involve sending waste to landfills or incineration without energy recovery (Richter, 2019). Landfills contribute to environmental pollution and resource depletion, so efforts should be made to minimize the amount of waste sent to landfills (Azimov et al., 2024). Logically, this should be the last on the scale of managing waste. According to Dijkgraaf and Vollebergh (2003) Waste Disposal methods, which include landfilling, incineration, etc., should be the last prioritized method of waste management. They propose the following order: reducing waste, then recycling or reusing it, before disposal.

1. Landfilling. Depositing waste in large, engineered sites designed to contain and isolate it from the environment. It is considered the least preferred option due to space consumption and potential environmental risks. Landfilling is the least preferred option due to its space consumption, high risk of environmental contamination, and inefficient energy use.
2. Incineration. The process of using high temperature heat to burn waste in order to reduce its size.

Implication of Knowledge on Wastes Management

We have learned from this section that knowledge helps shape perceptions, attitudes, and waste management practices for environmental sustainability. We specifically noted that when individuals, households, communities, and authorities have knowledge on waste segregation, composting, recycling, and reduction methods, they are about to take meaningful make decisions toward sustainable waste management practices. By promoting awareness, education, and public participation, waste management knowledge fosters a culture of environmental responsibility, minimizes environmental impact, conserves resources, and contributes to a healthier and more sustainable planet.

Perception

Effective manage waste is not to knowing some waste management techniques. Another variable that influences the way wastes are managed is people's perception or worldview of waste. Municipal waste management is a major issue facing cities of all sizes, regardless of the backgrounds of their citizens. It consistently ranks among the top five most difficult issues facing city administrators (Sankoh et al., 2013).

Writers have tried to explain the concept of perception. Most people define "perception" as the main way that people gather information about their surroundings. The term perception typically refers to a belief or impression formed by individuals or groups, often based on appearances or subjective experiences. According to Cambridge Dictionary, it is "a belief or opinion, often held by many people and based on how things seem." Collins Dictionary elaborates that perception involves "the way that you think about it or the impression you have of it," highlighting its subjective

and interpretive nature. In essence, perception shapes personal and collective viewpoints, reflecting how information or experiences are mentally processed and interpreted.

Perception of proper waste management refers to the way individuals or communities understand and interpret the practices and principles associated with the effective and responsible handling of waste. This perception is shaped by various factors, including cultural, social, economic, and environmental considerations. Perception is a major factor in defining how individuals and communities behave when it comes to waste management. It also influences the adoption of sustainable practices and improves the environment.

Studies have shown that perception does not always have a significant impact of waste management practices. For instance, a study in Ghana's Kassena Nankana East Municipality found that there was weak correlation between the education level of respondents and proper waste management practices, and only a mildly positive correlation between waste awareness and the effectiveness of policies and legislation. In this study, a major amount (42.1%) of the respondents said they preferred open burning and dumping (18.8%) as methods of disposing their wastes (Anokye et al., 2024). This shows the need for intervention.

A similar study was done in Durban, South Africa which revealed that while people held positive perception toward household waste, they believed it was the sole responsibility of the city authorities to management their wastes (Thakur & Onwubu, 2024).

In a study conducted in Gasabo District of Rwanda, focusing on the importance of community education, engagement, and government support in improving waste management practices, find out that there a need for teamwork

among stakeholders and residents in order to have a sustainable waste management to be achieved (Yeenee et al., 2024).

A study by Fadhullah et al. (2022) in Malaysai on household solid waste management practices and perceptions found that among 338 respondents in the study, approximately half practiced waste segregation at home. However, statistical analysis revealed no significant difference between those who segregated waste and those who did not ($\chi^2 = 0.12$, $p = 0.91$), indicating that perceptions did not significantly influence waste management practices (Fadhullah et al., 2022).

In a cross-sectional study in rural Mysuru district, India, researchers examined the perception and practice of household solid waste management. The study found that while residents had varying perceptions about waste management, these perceptions did not significantly correlate with their actual waste management practices (Rakesh et al., 2024).

A study exploring waste management practices and public perception in the Pelagonia Region of North Macedonia found that citizens' waste sorting practices were influenced by age and employment status, but not significantly by their perceptions of waste management policies. This suggests a weak or non-significant correlation between perception and practice (Powle et al., 2024).

Collectively, these studies suggest that while residents' perceptions and attitudes toward waste management policies are important, they may not directly translate into improved waste management practices. Instead, a combination of factors, including individual responsibility, community engagement, and effective governmental support, plays a more significant role in shaping sustainable waste management behaviors. However, there are also some studies that show that perception has a relationship with practice.

A study assessing local communities' perceptions on domestic waste management in Gasabo District, Rwanda, identified a clear correlation between community perception and waste management practices. Positive perceptions and awareness often translated into more responsible waste disposal behaviors, showing the importance of cultivating a supportive community perception towards waste management (Yeenee et al., 2024).

Research conducted in Ilorin metropolis, Kwara State, Nigeria, assessed community perception on waste management practices. The results showed a statistically significant difference in the perception of residents on waste management practices based on demographic factors, indicating that perceptions did influence actual waste management behavior (Okoji et al., 2023).

A study evaluating public perception and municipal solid waste management in Tabuk City, Saudi Arabia, found that public awareness and perceptions significantly influenced waste management practices. The study emphasized that enhancing public perception through education and awareness campaigns could lead to improved waste management behaviors (Al-Rashed, 2025).

Effective waste management relies on public perception and participation. Studies across different regions highlight how awareness, accessibility, and cost influence community engagement in sustainable waste disposal practices.

In their studies, Fakunle (2024) discovered that the residents who reduced their production of waste within their homes knew the health risks that comes with improper waste management. They were positively inclined towards proper waste management; however, among the major challenges they faced were the methods, and the expense associated with waste management. Komba (2021) assessed the perception and attitude of residents towards municipal solid waste management

practice in Freetown Central Zone of Sierra Leone. The management of solid wastes was perceived by residents as the central environmental concern.

People's thought about waste management plays a significant role in influencing its effectiveness at the local level. For waste management initiatives to be successful, public attitudes and awareness regarding appropriate disposal and recycling are essential. For example, the lack of frequent waste disposal services and inaccessible of public solid waste collection stations in Ilorin West, Kwara State, Nigeria, contributed to the locals' largely unfavorable opinions of waste management techniques. Despite being aware of the negative effects of waste disposal in close proximity, many locals stated that they would not go far to do so, emphasizing the necessity of easily available waste disposal infrastructure to increase community involvement in appropriate waste management practices (Okoji et al., 2023).

In a similar vein, a study carried out in Colombo, Sri Lanka, discovered that residents were willing to support waste segregation if containers were given away for free. The result also showed that 37% of those surveyed showed no interest in waste management, and 78% were unwilling to pay for valuable services (Nuzrath & Ruzaik, 2023).

These results would thus signify a two-fold approach in implementing effective waste management in Colombo: the availability of free and accessible waste management facilities like bins and frequent collection services, and a shift in residents' attitude through engagement and education for encouraging the uptake of sustainable measures. Both studies show that public perceptions, accessibility, and cost-related factors are key to overcoming barriers and achieving effective waste management practices.

Economic Factors

Economic factors such as perceived convenience and financial costs have a big impact on household recycling practices. Budgets and profits are the primary drivers of an individual's utility (Bishnoi et al., 2022). The rational choice theory was put into practice by Rompf (2014). According to this theory, “a person engages in recycling and waste segregation only if the anticipated recycling value, less the associated costs, exceeded that of conventional waste removal.” Bishnoi et al. (2022) asserts that reasonable people won't classify waste as belonging to “a minute or no pecuniary benefit.”

Therefore, promoting waste management requires addressing the financial incentives and reducing associated costs to make recycling a more attractive option for households. Emphasizing the economic benefits of recycling could enhance participation and shift household practices toward more sustainable waste management.

Government’s Responsibility

Until recently, waste management was thought to be the duty of the government, funded by general revenues, in most of the world's nations, particularly developing and transitional nations as well as social democracies in Europe (Kaza et al., 2018). Household perceptions regarding waste management can be influenced by laws that are clear and strictly enforced. Households are more likely to believe that waste management is the responsibility of the government when strict waste management policies are implemented and enforced (Fadhullah et al., 2022).

Conversely, there is less pressure on governments to implement comprehensive waste management systems in economically disadvantaged areas as households prioritize other pressing needs over waste management (Asian

Development Bank, 2019). On the other hand, affluent areas might insist on stricter guidelines and more creative waste management techniques (Sakai et al., 2019). However, Government programs that actively involve communities in waste management such as recycling campaigns and community clean-up days have the power to improve public perceptions of government accountability and cultivate a sense of shared responsibility (David, 2023).

Programs that provide education and information are essential for improving recycling in an efficient manner. Providing citizens, especially children, with information about what constitutes recycling and how to recycle will change their behavior toward recycling. No matter where they live, children's primary school education encourages and promotes recycling behavior (Dhir et al., 2021). Children can also act as advocates for recycling issues in their households by encouraging and pressuring their parents to recycle waste.

The implication of this on waste management is that government involvement through clear laws and enforcement can shape household perceptions and participation in waste management. There should also be awareness programs especially for children to instill these waste management practices in them. The involvement of the community will help enhance citizens' feelings of government responsibility and encourage shared duty for waste management.

Environmental Health Impact

The perceptions of households towards the impact of waste management on the environment and human health is complex and is determined by a variety of factors including education, access to information, cultural values, socioeconomic status, and local waste management infrastructure among others. Research by Fadhullah et al. (2022) in Kelantan, Malaysia, indicates that sociodemographic

characteristics such as income and level of education significantly influence household waste management attitude and behavior. The study established that poor waste management is caused by a lack of resources, human labor, and insufficient transportation. To worsen the situation, there are some unhealthful segregation practices for waste that are not widely known. Similarly, studies conducted in Kathmandu, Nepal, by Flacke et al. (2022) show how uncontrolled urbanization and industrialization lead to environmental problems with bearings on public health. The research focused on the household perceptions of environmental biases, particularly in air quality and drinking water quality. Access to good water sources, exposure to harmful pollutants from motor and industrial exhaust, and other elements all had an impact on perceptions.

Abubakar et al. (2022) research validated that unsustainable waste management has a negative impact on the sustainability of the environmental and on public health. The impacts are intensified by urbanization and the financial challenges of institutions. These practices as promoted by the authors have negative impacts on the environment, such as deforestation, air and water pollution, and global warming. It has important environmental and public health consequences to the inhabitants, who are largely members of marginalized social groups.

The majority of the households are of the opinion that improper waste management can lead to water, air, and land pollution, among other environmental issues. Improper waste management is largely thought to lead to health issues, such as respiratory diseases due to trash burning, water-borne diseases due to polluted water bodies, and vector-borne diseases due to breeding sites such as rats and mosquitoes (D. Kumar, 2020). Nonetheless, as Brotosusilo et al. (2020) maintained, households that have knowledge on waste management and the environment have improved their

habits and attitudes. Access to information regarding the risks of poor waste management and advantages of good practices can greatly enhance household practices (Noufal et al., 2021).

Personal Health Impact

To develop efficient waste management policies requires understanding how households perceive the effects of waste management on their personal health. This further requires examining a variety of aspects, including knowledge, financial ability, access to services, personal and cultural beliefs (Fadhullah et al., 2022; Noufal et al., 2021). Rana and Ganguly (2020), observe that among the immediate health hazards that households commonly perceive as a result of poor waste management are respiratory issues from burning waste, digestive disorders from contaminated water, and vector-borne infections.

Empirical research repeatedly shows that the public's perception of the health implications of waste management differs significantly depending on the kind of community they stay in, their socioeconomic status, and their level of educational (Abur et al., 2024; Saat et al., 2018). Even though the majority of people are aware of the harmful health implications of incorrect waste management practices, proactive measures and specialized expertise are often lacking (Abur et al., 2024). Protecting the health of individuals and communities requires raising public awareness and promoting improved waste management techniques. These actions include infrastructural upgrades, community education initiatives and effective policies. Higher awareness levels are often associated with better waste management practices (Sewak et al., 2021).

A study conducted in Nigerian cities found that although waste management is well understood, many individuals are not fully aware of the specific health problems

connected with poor disposal of waste (Adekola et al., 2020). Rana and Ganguly (2020) opined that two of the most commonly recognized health impacts were respiratory issues and infectious infections. People who live in rural areas often consider trash management to be less significant than those who live in urban areas (Limon et al., 2020). However, it is becoming more and more clear that poor waste management is linked to diseases.

The study by A. Kumar and Agrawal (2020), which focused on urban households in India, found a direct correlation between waste management technique knowledge and perceived health consequences. Households that were more knowledgeable reported fewer health issues linked to waste. According to Sinthumule and Mkumbuzi (2019) community intervention study in Zimbabwe, educational programs significantly increased the public's knowledge of and use of waste management practices. Participants said they were more aware of the link between improper garbage disposal and illnesses such skin infections and respiratory conditions.

For waste management policies and practices to be effective, it is imperative to comprehend how households perceive the effects of waste management on their personal health. It is possible to improve public awareness and proactive waste management behavior by addressing issues including awareness, service accessibility, economic situations, individual and cultural views. To protect individual and community health, governments can reduce health hazards such as respiratory problems, and digestive disorders by putting in place community education programs, effective legislation, and infrastructure upgrades.

Infrastructure

Effective waste management is a key component of sustainable urban and rural development. It comprises the systematic handling of the production, storage, collection, transportation, processing, and disposal of waste materials. Several factors, such as population and policies contribute to the wide regional and national disparities in the availability and efficacy of waste management infrastructure.

The substantial influence of waste management infrastructure on citizens' waste disposal habits has been brought to light by recent studies. According to studies conducted in Logia Town, Ethiopia, families that had access to suitable disposal places for trash were six times more likely to practice appropriate waste management than those that did not. Furthermore, it was determined that the lack of door-to-door waste collection services was a major risk factor for inappropriate waste management practices. This reveals the significance of regular and convenient waste collection services in encouraging appropriate waste disposal practices (Asfaw et al., 2024).

Comparably, in Lilongwe, Malawi, a lack of waste management infrastructure—such as a shortage of trash cans and longer travel times to collection sites—made it more likely that garbage would be dumped in public spaces and along the sides of roadways (Geninyan et al., 2023). The study also found that authorities only collect less than 30% of the waste generated, which forced residents to use inappropriate disposal methods because there were not enough convenient and consistent insfrastructure (Ilomo & Charles, 2025).

Research conducted in in Durban, South Africa, found that although people had favorable opinions about handling domestic waste, they thought the government should be the only one in charge of it. Such mindset coupled with limited access to waste disposal services, underscores the need for tailored, context-specific

interventions that combine education and infrastructure improvements to promote effective waste management practices (Thakur & Onwubu, 2024).

Together, these studies indicate that people' waste management practices are significantly influenced by the accessibility and availability of waste management infrastructure, such as suitable disposal locations and consistent collection services.

Waste Collection Services

An efficient waste management system must include both the collection and transportation of solid waste. When these are carried out correctly, environmental contamination is avoided, and the health of the public is protected (Johansson & Krook, 2021). Methods of collection must take into account community-specific elements such as trash type and population size. Depending on the type of waste, the distance, and the strategy, different ways are used to transport it to treatment or disposal facilities after it has been collected (Abubakar et al., 2022).

According to Cintanesa et al. (2023), the collection and transportation of waste must adhere to all applicable regulations, including acquiring permits and fulfilling safety and environmental requirements. The success of such a system is depended on the education and participation public in recycling and waste reduction (Xiao et al., 2017). However, a lot of problems still exist, especially in developing nations of which Liberia is a part. These include lack of waste collection trucks, poor road condisions, and an increase in urban garbage as a result of population development (Batista et al., 2021). The location of informal settlements makes it difficult for trucks to enter them. Effective management is further hampered by a lack of public understanding regarding segregation (Hassan et al., 2024).

Lastly, investment in contemporary waste technology is constrained by financial constraints, and illicit dumping threatens established systems (Khan et al.,

2022). Planning, community involvement, infrastructure development, and sustainable practices must all be incorporated into integrated strategies to address these problems (Batista et al., 2021).

Recycling Facilities

Because they conserve non-renewable raw materials and lower the amount of waste that needs to be disposed of in the end, recycling facilities are essential to modern waste management systems. Recycling includes both the direct reuse of objects, such as used clothing and the recovery of materials, such as melting scrap iron, creating new glass from fragments, and repurposing construction debris into building materials (Mahartin, 2023).

Recycling comes with challenges. Although recycling prolongs the life of materials, it frequently reduces the recovered product's long-term usefulness and market value. Furthermore, there may be environmental externalities from the recycling process itself (Massoud et al., 2023). Significant energy use and carbon emissions can also come from industrial processes like melting or chemically treating recyclables (Ayodele et al., 2018).

Consequently, recycling has certain ecological repercussions even though it is still a praiseworthy habit. The environmental impact of recycling processes must be taken into consideration for waste management to be genuinely sustainable. This entails streamlining logistics, utilizing greener technologies, and creating plans that lower emissions throughout the recycling process.

Waste Disposal Facilities

To encourage responsible waste management practices at the individual, community, and industrial levels, public education and regulatory actions are essential (Adyel, 2020). Policies pertaining to the environment and public health nowadays

must include waste management and disposal. Trash collection, processing, and disposal methods that reduce health, and environmental hazards are all part of effective waste management. The layout and functionality of waste disposal facilities differ greatly, and they are all tailored to suit distinct waste kinds and regulatory contexts. Common types are composting facilities, recycling centers, incinerator plants, and landfills.

Landfills. Landfills are the most popular method of disposing of waste. Landfills are made to keep waste away from the environment, especially groundwater and soil. Leachate collection systems and liners are used in modern sanitary landfills to prevent contamination. Legally compliant landfills are used to store waste that is not suitable for thermal treatment or material recycling, such as residues from waste incineration. Waste needs to be pre-treated if it doesn't meet landfilling regulations (Ogunwumi & Salami, 2023). Nevertheless, despite its pertinent role in waste disposal, many developing nations are home to unregulated and illicit "landfills," also commonly referred to as open dumpsites (Siddiqua et al., 2022).

Iravanian and Ravari (2020) claim that despite regulations designed to reduce the impact of waste disposal, landfills nevertheless impair water, soil, air, and natural life. One of the primary sources of pollution in landfills is the leachate created when waste breaks down. Leachate can affect human health and contaminate water and soil resources. The four main types of contaminants that are present in leachate have the ability to affect both aquatic and soil-dwelling biological species.

Incinerator plants. Waste is burned at high temperatures in incinerator plants, which lower the waste's mass and volume. Both energy production and landfill space reduction are possible through incinerating waste (Zhang et al., 2023). Flammable household waste unsuitable for recycling are treated in waste incineration plants or

waste wood furnaces. The process releases heat that heats buildings and generates power. In industrial facilities such as cement plants, waste with a high calorific value and minimal emissions can be utilized in place of fossil fuels (Zhang et al., 2023).

Organic polluted waste is subjected to a different kind of thermal treatment (such as in facilities that incinerate hazardous waste). A system for treating flue gas is required for incinerators. The type of waste determines the specifications for the incinerator system and flue gas treatment (Thakur & Onwubu, 2024). Specialized waste disposal companies handle the waste according to the incinerator plant's specifications. This lowers the chance of an accident and ensures that the fuel will be of the highest quality. For instance, the companies make sure that when liquids are mixed, there are no unwanted reactions. Cement plants' waste materials used as alternative fuels need to be pre-crushed and calibrated to a consistent calorific value (Chen, 2018).

While incineration is a waste management method that can help reduce the volume of solid waste and generate energy, it also has several disadvantages and concerns. Chen, (2018) mention that incineration releases various pollutants into the air, including particulate matter, heavy metals (such as lead and mercury), nitrogen oxides, sulfur dioxide, and dioxins. These pollutants can have adverse effects on air quality and human health. The incineration process produces ash that may contain toxic substances and heavy metals. The reduction of hazards to the environment and public health is greatly aided by waste disposal facilities

Although landfills are frequently used to dispose of trash, improper management can endanger the quality of the soil, water, and air. Landfill leachate can contaminate water and soil resources, harming marine life and human health. Incineration on the other hand, can reduce waste volume and generate energy but may

release pollutants into the air and produce ash containing toxic substances if not managed appropriately.

Composting facilities. Organic waste is processed in composting facilities to create compost, which is then used as fertilizer. This procedure enhances soil health and lowers methane emissions from landfills. The process of composting is the biological breakdown of mixed wastes by a mixed microbial population, resulting in materials that resemble humus and are called compost. It is a method or technique used to recover or transform wastes, primarily organic, into other extremely beneficial uses (Pathak et al., 2021). It essentially entails the transformation of organic wastes, such as food wastes, leaves, sludge, fruits, animal waste, etc. by microorganisms into soil humus (Sánchez, 2023).

In order to limit these challenges and safeguard public health, waste management regulations should place a high priority on sustainable practices, effective waste treatment techniques, and appropriate disposal of waste. These are possible when responsible waste management practices are encouraged at the individual, community and industrial levels. Also, by public education, legislative initiatives, and the application of modern technologies.

Regulatory Framework/Policies

Government or policymakers are responsible for crafting laws for waste management (Tripathi & Prakash, 2022). Paasewe (2022) reported that Liberia does not have a separate waste policy. It is embedded within the National Environmental Policy of the Republic of Liberia of 2002.

The two agencies closely linked with waste management policies in Liberia are the Environmental Protection and Management Law and the Environmental Protection Agency (EPA). They provide the legal structure, and oversight

responsibilities in partnership with other government institutions and Non-Governmental Organizations.

As stated on their website, the EPA on November 26, 2002, by a legislative act and was formalized on April 30, 2003. The institution is the regulatory institution responsible for the sustainable management of the environment and its natural resources (Paasewe, 2022).

The integration of waste management within Liberia's broader environmental policy framework ensures a coordinated and comprehensive approach, emphasizing sustainability and compliance with international standards. The EPA's role in developing regulations, promoting public awareness, and enforcing compliance is crucial for effective waste management. This approach fosters international cooperation, public participation, and continuous improvement, positioning Liberia to better manage its waste and protect its natural resources.

Research Gap

A review of existing literature reveals that most studies have not examined the interaction of the three independent variables with the dependent variable simultaneously. Additionally, no study of this nature has been conducted within the Liberian context, highlighting a significant gap that this research seeks to address. The closest I discovered was Knowledge, perception and practice interacting with each other.

A study conducted by Jeremias and Fellizar (2019) in Sorsogon City, Philippines, assessed households' knowledge, awareness, perceptions, and practices regarding solid waste management (SWM). The results indicated that while a significant portion of respondents demonstrated average knowledge and awareness levels, these did not consistently translate into effective SWM practices. Notably, 82%

of participants engaged in waste segregation, and 85% sold recyclables, motivated by cleanliness and additional income. However, practices such as burning household waste and dumping garbage in rivers persisted. The study found weak correlations between SWM practices and factors like age, educational attainment, household size, income, and environmental knowledge. This suggests that knowledge and awareness alone may be insufficient to drive proper waste management behaviors, highlighting the need for enhanced information, education, and communication campaigns.

In Jigjiga Town, Ethiopia, as research find out that household knowledge plays a crucial role in determining waste management strategies and behaviors. A lack of information and awareness among families was linked to ineffective waste management, contributing to pollution and health concerns. The findings underscore the importance of understanding community perceptions and behaviors to develop effective educational and awareness campaigns that promote environmentally responsible waste management practices (González-Sánchez et al., 2023).

In Port Harcourt Metropolis, Nigeria, a study investigated the determinants of knowledge, attitude, and practices of refuse disposal methods among residents. The findings revealed high levels of knowledge (85%) and positive attitudes (81%) towards refuse disposal. However, only 63% demonstrated moderate practices. Factors influencing refuse disposal included access to waste disposal facilities (88%), cost (55%), peer influence (23%), lack of awareness (48%), and government policies (72%). Significant relationships were found between knowledge and practice, as well as attitude and practice, indicating that while residents possess knowledge and positive attitudes, practical implementation is influenced by infrastructural and policy-related factors (Chikowore, 2020).

These international studies collectively emphasize that while knowledge and perception are essential, the presence or absence of infrastructure and enabling policy frameworks often determines whether proper waste management is practiced. However, these findings cannot be directly transferred to Liberia without contextual validation. Liberia's unique urban demographics—particularly in Monrovia and Paynesville, characterized by high-density slum settlements and medium- to low-density affluent communities—demand localized inquiry.

This study fills a significant gap examining the combine influence of knowledge, perception, and infrastructure on waste management practices within urban Liberian communities**.** By comparing both slum and urban settings in the two most populated cities, the research offers critical, context-specific insights that inform both policy and community-level interventions. Thus, the study contributes not only to academic literature but also provides evidence-based recommendations for improving waste management in Liberia, tailored to the socio-economic and infrastructural realities on the ground.

Theoretical Framework

This Social Cognitive Theory (SCT) developed by Albert Bandura in 1986 was adopted by this study. This theory offers a comprehensive framework for understanding human behavior through a triadic model of reciprocal determinism. This model posits that behavior is influenced by the dynamic interplay between personal factors, environmental influences, and the behavior itself (Bandura, 1986). The theory emphasizes that individuals are not passive recipients of environmental stimuli but active agents who shape and are shaped by their environments through observation, interpretation, and feedback. The major concepts of the SCT include self-

efficacy, observational learning, outcome expectations, and behavioral capability as stated by (Schunk, 2012).

His primary experiment was Bobo Doll experiments; it indicated that individuals, especially children, learn comportments through imitation and experience (Schunk, 2012).

The SCT has been effectively used by academicians over the years to understand recycling, preventing, and waste management. For instance, interventions that enhance individuals' self-efficacy and provide community-based models of proper waste behavior have led to increased participation in waste sorting and reduction of single-use plastic consumption (Nickerson, 2025). These applications demonstrate SCT's utility in addressing not only individual psychological factors but also community-wide environmental issues. The theory provides a robust and integrative framework to interpret how these determinants interact to shape behavior. The study will consider how this theory is applicable to each of the variables in the current studies with examples.

In SCT, behavioral capability refers to an individual's knowledge and skills necessary to perform a behavior. In this study, knowledge pertains to the residents' understanding of proper waste disposal techniques, environmental risks, and health implications associated with improper waste management. The absence of knowledge indicates a low behavioral capability, which hampers individuals' ability to act even when infrastructure is available (Schunk, 2012). For example, a household in Paynesville City or Monrovia City may have access to a waste bin but still dispose of trash improperly due to lack of knowledge on the importance of waste segregation or timing for waste collection.

In SCT, outcome expectancy portrys what individuals believe will happen if they engage in a specific behavior, while self-efficacy means confidence in their ability to perform that behavior effectively. Perception, as explored in this study, refers to how residents view the importance of waste management, their perceived role in maintaining cleanliness, and their confidence in their ability to manage waste properly. A positive perception of waste management, such as believing that proper disposal improves community health, correlates with high outcome expectancy and predicts consistent behavior. On the other hand, Low self-efficacy hinders engagement, even if knowledge and infrastructure are present. For instance, when a community dweller believe that his or her efforts may not make a difference because the government is not collecting waste.

In this theory, environmental factors are external conditions that support or hinder behavior. Infrastructure in this study includes the availability of waste bins, access to collection services, drainage systems, and functioning waste management policies. Without supportive infrastructure, residents face environmental barriers that limit their ability to carry out what they know or believe is correct. The theory acknowledges that even motivated and knowledgeable individuals may not perform desired behaviors if the environment does not support them (Bandura, 1986). For example, a resident may know how to manage waste and believe in its benefits, but if no bin is available within a reasonable distance, their behavior will likely not align with that knowledge.

The dynamic interplay between knowledge (personal factor), perception (cognitive factor), infrastructure (environmental factor), and actual waste practices (behavior) reflects Bandura's core principle of reciprocal determinism. Each element influences and is influenced by the others. For example, poor infrastructure in the

communities of Monrovia and Payneville cities may negatively influence perception, which in turn affects practice. Improved knowledge through training may increase self-efficacy and empower residents to advocate for better infrastructure. Therefore, this theory offers a useful application for comprehending how waste management practices in Montserrado County are determined by different factors.

CHAPTER 3

RESEARCH METHODOLOGY

In this chapter, the researcher outlined the approach that was used in conducting the researcher's approach. The major components of this chapter are the design of the research, the population, sample size and the sampling procedure used to determine the sample, the method of data collection and analysis, and lastly the reliability and validity of the study.

Research Design

This study adopted a quantitative, cross-sectional design to show the relationship between the independent variables, knowledge, perception, and infrastructure and the dependent variable, waste management practices among residents of Monrovia and Paynesville. This approach is involved with collecting data at a particular time in order to analyze relationships among variables (Queirós et al., 2017). Quantitative deals with gathering and analyzing numerical data to explain a the phenomenon or relationship (Asamoah, 2014).

Population and Sampling Procedure

The population and sampling plan are described in this section. The focuses of this section is on the dwellers of the two most crowded urban areas in Liberia, Monrovia and Paynesville.

Population

Bhandari (2020) define population as the total number of people or cases one want to collect data for analysis. The population for this study comprises residents of the two most populated cities in Montserrado County, Liberia—Paynesville and Monrovia. As per the 2022 census, Montserrado County houses 1,920,965 individuals, with 1,643,936 (85.57%) residing in Greater Monrovia, accounting for 31.3% of the national population. Monrovia, the capital city, has a population of 161,891 (8.4% of Montserrado County), while Paynesville City has a population of 617,492 (32% of Montserrado County). Together, these two cities account for a significant portion of Montserrado County's population, making them suitable for this study. The 2022 Liberia Population and Housing Census recorded a total of 1,157,514 households in Liberia. The average household size was 4.4 persons (Liberia Institute of Statistics and Geo-Information, 2022). Therefore, the population is 177,132 households comprising the populations of the Monrovia and Paynesville Cities.

Monrovia and Paynesville Cities are ideal sites for this study because they represent a large portion of Montserrado County’s urban population and show a wide range of socio-economic and infrastructural conditions. These cities face some of the most severe waste management challenges in Liberia, including open dumping, limited access to disposal facilities, and varying levels of public awareness. Their diversity in community types—ranging from high-density slums to low-density residential areas—also provides a useful contrast in waste management practices and challenges.

Sampling

Given the large and diverse nature of the population and that they are located differently, the population exists in categories; therefore, Quota Sampling is employed

to ensure a representative selection of households across various demographic and socioeconomic strata. The target population for this study comprises households in Monrovia and Paynesville, the two most densely populated cities in Montserrado County, Liberia. According to the Liberia Institute of Statistics and Geo-Information (2022), Montserrado County has a total population of 1,920,965 individuals, with 85.57% residing in Greater Monrovia, which constitutes 31.3% of the national population. Specifically:

1. **Monrovia** has a population of 161,891 (8.4% of Montserrado County's total).
2. **Paynesville** has a population of 617,492 (32% of Montserrado County's total).
3. The total estimated number of households in these two cities is 177,132, based on an average household size of 4.4 persons.
4. Therefore, the allocation of the sample will follow the population proportions:
5. **Monrovia** received 20.78% of the total sample size.
6. **Paynesville** received 79.22% of the total sample size.

To ensure equal representation, the study employs Quota Sampling**,** giving each of the geographical and socioeconomic areas a quota in proportion to their population as seen below:

1. **Geographic Location** – The two most populated cities are Monrovia and Paynesville.
2. **Community Type** – High-density (slum areas) with socioeconomic low income, and medium-density or low-density neighborhoods with socioeconomic high income.

Sample Size Calculation

This study utilized Cochran's formula to calculate the sample size. It is a statistical technique used to calculate the sample size for a given population when the goal is to achieve a specific level of accuracy and confidence in the survey results. It is often used in social research to determine how many subjects need to be included to

make inferences about a population. According to Cochran's formula for determining sample size, a population of 177,132 will have a sample size of 384. Here is the calculation.

$$n_0 = \frac{z^2 p(1-p)}{e^2}$$

N_0 is the sample size, and z is the selected value of desired confidence level; p is the estimated proportion of an attribute that is present in the population, q p = −1 and e is the desired level of precision. The maximum variability is equal to 50% (p =0.5) and taking 95% confidence level with 5% precision, the calculation is as follows: p = 0.5 and hence q = 0.5; e = 0.05; z =1.96

$$n_0 = \frac{1.96^2 \times 0.5(1-0.5)}{0.05^2} = 383$$

Thus, the final sample size is 383 households. Monrovia will be allocated 20.78% of the total sample (383), amounting to approximately 80 households, while Paynesville will receive 79.22%, totaling approximately 303 households, based on their respective proportions.

A total sample of 383 households is selected using proportional allocation, ensuring that each city's representation aligns with its population size. The sample is distributed as follows:

1. Paynesville (79.22% of the total sample):
    a. Total: 303 households.
    b. High-density (slum areas) with socioeconomic low income: 151 households.

c. Medium-density or low-density neighborhoods with socioeconomic high income: 152 households.

2. Monrovia (20.78% of the total sample):
    a. Total: 80 households.
    b. High-density (slum areas) with socioeconomic low income: 40 households.
    c. Medium-density or low-density neighborhoods with socioeconomic high income: 40 households.

Participants will be intentionally selected within each category to meet the required quotas, ensuring that the sample adequately reflects the diversity of household characteristics in Monrovia and Paynesville. This approach ensures the inclusion of key groups relevant to the study without relying on random selection.

Instrument for Data Collection

The data collection instrument for this study was a questionnaire consisting of closed-ended, structured questions. It was developed by the researcher based on the research questions and insights drawn from the reviewed literature. The questionnaire is divided into five parts.

The first section provided basic demographic information about each respondent, such as gender, age, marital status, employment, and education. The second section assessed the respondents' knowledge of waste management. The third section asked questions on the respondent's perception of waste management, while the fourth section focused on the respondents' access to waste management infrastructure. The Likert scale was applied to sections 2 through 5 as responses for the structured close-ended questions.

Validity and Reliability

The questionnaire was assessed in a pilot test to check its validity and reliability. This pilot test was done in Gardnerville Community which is one of the

townships of Montserrado County. It helped the researcher to reword and change some questions for clarity where appropriate. Twenty households were chosen randomly for the pilot test and will not be part of the survey as recommended by (Saunders, 2012).

A four-part questionnaire was sent to 30 respondents in the Gardnesville Community. The Waste Management Knowledge subscale consisted of 7 items (α = .82), the Waste Management Perception subscale consisted of 8 items (α = .87), and the Waste Management Infrastructure subscale consisted of 8 items (α = .93). The primary advisor, Prof. Erhuvwukorotu Kollie of Oakwood University, and secondary advisor, Dr. Janet Odhiambo of Adventist University of Africa, validated the instrument for data collection.

In addition, the questionnaire was reviewed for content validity by experts who teach in the field of Public Health. They provided recommendations particularly in the areas of language clarity and the alignment of the questionnaire items with the research questions.

Table 1.

Validity and Reliability Table

	Items	Cronbach Alpha Value(α)	%
Waste Management Knowledge	7	.821	82%
Waste Management Perception	8	.869	87%
Waste Management Infrastructure	8	.931	93%
Waste Management Practices	11	.831	83%

Data Collection Procedure

The researcher obtained the required study approval from the University before beginning the data process. After being given permission, the researcher

visited the chosen communities to speak with community leaders explain purpose and method of data collection. The following steps were followed in collecting the data.

Community Engagement

The researcher visited the community leaders to explain the purpose of the research and to obtain permission from them.

Household Visits

After obtaining permission from the leaders, the researcher, along with the trained research assistant, went from household to household in order to collect the data. When the household leaders agreed to participate in the survey, the researcher or assistants give them the questionnaire and helped them understand the content for those who could not. This process for each respondent took about 30 minutes.

Questionnaire Administration

The questionnaires were administered directly by the researcher or assistants. And they were encouraged to complete the questionnaire in one sitting.

Assistance and Monitoring

To ensure quality data collection, research assistants met the following criteria:

1. **Educational Background** – A minimum of a diploma or bachelor's degree in social sciences, environmental studies, public health, or a related field.
2. **Training in Research Methods**. They were trained for the data collection.
3. **Communication Skills**. They had the ability to communicate with the respondent in the local language.
4. **Appointment:** After obtaining approval from community leaders, households were visited at random. In some cases, appointments had to be rescheduled to accommodate the availability of respondents.

5. Although the researcher and assistants were present during questionnaire administration to provide clarification when necessary, every effort was made to reduce social desirability bias. Respondents were encouraged to answer independently and honestly without fear of judgment. The researcher maintained a non-intrusive presence and avoided influencing responses, ensuring that participation remained voluntary and confidential.

Method of Data Analysis

The statistical analysis used in this study were regression and correlation analysis to test relationships. The Statistical Package for Social Sciences (SPSS) version 27 was used for all data analysis. With the aid of data analysis software, researchers ran various analyses on the collected data, identified potentially significant relationships, and conducted frequency analyses. The survey answers were converted to an Excel file after coding. In general, the study tested the relationships between the independent and dependent variables as well as the central tendencies using descriptive statistics.

Table 2.

Correlation and Multiple Regression Analysis Table

Research Question	Description	Statistical Treatment
1.	Is there a relationship between the level of knowledge of residents and their waste management practices?	Correlation Analysis
2.	Is there a relationship between the perception of residence and waste management practices?	Correlation Analysis
3.	What is the relationship between the waste management infrastructure and waste management practices?	Correlation Analysis
4.	Is there a relationship between a combination of knowledge, perception, and infrastructure and waste management practices?	Multiple Regression
5.	Does the demographic profile moderate the relationship between the independent and dependent variables?	Correlation Analysis

The Pearson Correlation analysis was used to identify the magnitude and direction of the relationship between knowledge, perception, and infrastructure with waste management practices. However, while correlation shows relationship, it does not establish predictive relationships or account for the combined effect of multiple variables. Therefore, regression analysis was used to determine how well the independent variables (knowledge, perception, and infrastructure) predicted the dependent variable (waste management practices).

Ethical Considerations

Approvals and Permission

Study of this nature requires permission and approvals from relevant authorities. For this study, the researcher obtained an approval letter from Ethics Review Board of the Adventist University of Africa. This letter introduced the intent and purpose of the study as well as stating that the researcher meets ethical standards.

Informed Consent

The letter of informed consent outlined the rights of the participants, the policies, and procedures that were implemented to protect participants' privacy and data confidentiality, as well as the voluntary nature of participation in the study and the policies on withdrawing from the study. The researcher prepared a consent form that each respondent signed indicating their willingness and commitment to participate in the study.

Anonymity and Confidentiality

The respondents were properly educated about the points regarding the study and that they can choose not to finish the questionnaire at any time and under any condition, as participation is voluntary. The information of the respondents was taken

care of in an anonymous way, with a code assigned to them. There was no type of deception used to gather data from the respondents.

Voluntary Participation or Autonomy

Respondents were informed that they could withdraw from the survey at any time convenient to them if they feel threatened and their responses would be deleted from the survey. The data that was collected from the respondents was obtained without any form of deception. Respondents were assured that the data collected will be utilized for academic purposes only and will not lead to any defamation.

Data Management

The researcher managed the research data responsibly, ensuring that all aspects of data collection, storage, and sharing respect the rights and interests of participants. The following practices were implemented to maintain data integrity and security:

1. Data Collection. Data was collected using standardized questionnaires administered during household visits. All responses will be recorded accurately to ensure the reliability of the information gathered.

2. Data Storage. Collected data were stored securely in password-protected electronic files and on secure servers. Physical copies of questionnaires, if any, will be kept in locked cabinets accessible only to the researcher and authorized personnel. Backup copies are maintained to prevent data loss for a period of 1 year.

3. Data Sharing. The researcher ensured that any sharing of data, whether for research purposes or publication, is done in compliance with ethical guidelines and legal requirements. Appropriate permissions were obtained from participants before any data sharing occurs. Data were anonymized or de-identified to protect participants' identities, ensuring that no personal information can be traced back to individual respondents.

4. Participant Rights. Participants were informed of their rights regarding data privacy, including their right to access their data, request corrections, and withdraw from the study at any time without penalty. This outlined clearly in the informed consent form provided before participation.

5. Duration of Data Retention. Data will be retained for a specified period after the completion of the study, as required for verification and publication purposes, after which it will be securely disposed of to prevent unauthorized access.

CHAPTER 4

RESULTS AND DISCUSSION

This chapter examined the research questions and hypotheses outlined in Chapter 1. Each research question and its corresponding hypothesis were addressed using the relevant SPSS Tables. Subsequently, the findings are analyzed in relation to existing literature to provide context and interpretation.

Research Question 1 and Hypothesis 1: Relationship Between Waste Management Knowledge and Waste Management Practices

Research Question 1: What is the relationship between the level of knowledge of residents and their waste management practices?

Null Hypothesis (H_{01}): There is no significant relationship between the level of knowledge of residents and their waste management practices.

Table 3.

Correlation Between Waste Management Knowledge and Waste Management Practice

		Waste Management Knowledge	Waste Management Practice
Waste Management Knowledge	Pearson Correlation	1	.302**
	Sig. (2-tailed)		.000
	N	372	372
Waste Management Practice	Pearson Correlation	.302**	1
	Sig. (2-tailed)	.000	
	N	372	372

**. Correlation is significant at the 0.01 level (2-tailed).

Note. N = 372. Correlation is significant at the 0.01 level (2-tailed).

To examine the relationship between residents' knowledge of waste management and their corresponding practices, a Pearson product-moment correlation was conducted using data from 372 respondents. The test assessed whether higher levels of knowledge are associated with better waste management practices.

The analysis revealed a moderate positive correlation between the level of waste management knowledge and waste management practice, $r(358) = .302$, $p < .001$. This result is statistically significant at the 0.01 level (two-tailed), indicating that there is meaningful relationship between the two variables. The findings suggest that as residents' knowledge of waste management increases, their engagement in proper waste management practices also tends to improve. The statistically significant correlation coefficient of $r = .302$ suggests that increasing public knowledge about waste management is likely to enhance residents' waste management practices.

As such, the null hypothesis is rejected. Therefore, we conclude that there is a significant positive relationship between the residents' knowledge of waste management and their actual waste management practices. The findings of the current study resonate with a growing body of empirical research that has explored the correlation between residents' knowledge and their waste management practices. For instance, a study conducted in Ban Khlong Phai, Thailand, investigated the level of household waste management knowledge and behaviors among residents. Despite reporting a low mean knowledge score ($M = 5.23$, $SD = 0.80$), participants demonstrated moderate levels of practice ($M = 1.37$, $SD = 0.37$). Notably, a significant positive correlation was observed between knowledge and waste management behavior ($r = 0.16$, 95% CI [0.047, 0.279], $p < .05$), suggesting that even minimal increases in knowledge could contribute to improved waste practices (Fadhullah et al., 2022).

In a study by Zhang et al. (2023) on some healthcare workers revealed a that there was statistically significant correlation between knowledge and practice. The result implied that higher knowledge the responded had, correlated with better compliance with waste management practice. Moreover, another study conducted by Laor et al. (2018) in municipal solid waste management reaffirmed the trend. Under the research, it was observed that individuals with greater levels of knowledge tended to dispose of waste more responsibly, thereby reaffirming the application of educational and informative strategies towards fostering ecologically sustainable behavior.

Other research evidence from college settings also concurs with this fact. A study that looked at how environmental, knowledge, and waste management practices among university students correlate concluded that environmental knowledge actually predicted practice significantly (Ridayani et al., 2008). Besides, in a study that was conducted in Darmian city, South Khorasan Province, Iran, participants with higher knowledge scores significantly practiced waste management with better habits (Sahlabadi et al., 2024). It is clear that such evidence shows that household knowledge gain is an important determinant of desirable waste management practices.

Taken together, these studies collectively show a consistent empirical trend: increasing public knowledge and awareness regarding waste management positively influences actual practices. In other words, there is a relationship between knowledge and practice of waste management. This convergence of evidence further validates the current study’s findings and supports the conclusion that public education and awareness-raising efforts are essential for fostering sustainable and effective waste management behaviors.

Research Questions 2 and Hypothesis 2: Relationship Between Perception and Waste Management Practices

Research Question 2: What is the relationship between residents' perception of waste management and their waste management practices in Montserrado County?

Null Hypothesis (H_{02}): Perception of residents does not influence their waste management practices.

Table 4.

Correlation Between Waste Management Perception and Waste Management Practice

		Waste Management Perception	Waste Management Practice
Waste Management Perception	Pearson Correlation	1	.067
	Sig. (2-tailed)		.203
	N	360	372
Waste Management Practice	Pearson Correlation	.067	1
	Sig. (2-tailed)	.203	
	N	372	372

To evaluate whether residents' perceptions of waste management policies influence their actual waste management practices, a Pearson correlation coefficient was computed between the variables “waste management perception” and “waste management practice.” The analysis involved 372 cases. The result revealed a weak positive correlation between residents' perceptions and their practices, $r(358) = .067$, $p = .203$.

However, the correlation was not statistically significant at the 0.05 level. This result indicates that there is no meaningful relationship between how residents perceive waste management perception and how they practice waste management. The correlation analysis indicates that residents’ perceptions of waste management

policies are not significantly associated with their actual waste practices. Thus, the null hypothesis (H_{02}) is retained. The data does not provide sufficient evidence to conclude that perception significantly influences waste management behavior.

The relationship between people's perception and actual waste management practices has yielded mixed findings in recent scholarly studies. In Panji Sub-District, Kota Bharu district, Kelantan, Malaysia, a study assessing household solid waste management practices found that although approximately half of the 338 respondents practiced waste segregation at home, statistical analysis showed no significant difference between those who did and did not ($\chi^2 = 0.12$, $p = 0.91$). This indicated that public perceptions did not significantly influence their waste management behaviors (Fadhullah et al., 2022). Similarly, a cross-sectional study in the rural Mysuru district of India reported that variations in household waste management practices were not significantly associated with community perceptions. Although residents held differing views on waste management, these perceptions did not translate into improved practices (Rakesh et al., 2024).

A comparable conclusion emerged from research in the Pelagonia Region of North Macedonia. This study examined factors influencing citizens' waste sorting practices and discovered that while age and employment status were significant variables, perceptions of waste management policies were not. This suggests a weak or non-significant relationship between perception and practice in this context (Angeloska-Dichovska et al., 2023). These findings are in agreement with the findings of this research. However, there are other findings that are in contrast with the findings of this research.

Studies have found a significant relationship between perception and practice. In Gasabo District, Rwanda, local community perceptions positively correlated with

responsible waste disposal behaviors. Positive awareness and attitudes towards waste management translated into more conscientious disposal practices, indicating that community perception can play a vital role when supportive environmental awareness is present (Yeenee et al., 2024). Similarly, in Ilorin metropolis, Kwara State, Nigeria, demographic factors influenced how residents perceived and practiced waste management. The study demonstrated a statistically significant link between perception and behavior, emphasizing the role of localized community dynamics (Okoji et al., 2023).

In Tabuk City, Saudi Arabia, research also confirmed a strong influence of public perception and awareness on municipal solid waste management behaviors. The study recommended intensified public education and awareness campaigns as a strategy to improve waste practices (Qasim & Shareefdeen, 2022). These contrasting outcomes reveal that while perception may have minimal influence on waste management in certain contexts, it becomes a stronger determinant when supported by other factors.

Research Questions 3 and Hypothesis 3: Relationship Between Infrastructure and Waste Management Practices

Research Question 3: What is the relationship between the availability and accessibility of waste management infrastructure and residents' waste management practices?

Null Hypothesis (H_{03}): The accessibility of waste management infrastructure does not significantly influence residents' waste management practices.

Table 5.

Correlation Between Waste Management Infrastructure and Waste Management Practice

		log_ Waste Management Infrastructure	log_ Waste Management Practice
log_ Waste Management Infrastructure	Pearson Correlation	1	.471**
	Sig. (2-tailed)		.000
	N	360	372
log_ Waste Management Practice	Pearson Correlation	.471**	1
	Sig. (2-tailed)	.000	
	N	372	372

**. Correlation is significant at the 0.01 level (2-tailed).

To find out whether the availability and accessibility of waste management infrastructure have a influence on the waste management practices of residents, a Pearson correlation coefficient was used. The result showed a moderate positive correlation, $r(358) = .471$, $p < .001$. This infers that an increase in the accessibility and availability of infrastructure is significantly associated with an increase in residents' waste management practices. This statistically significant, moderate association reveals that when residents are provided with access to waste infrastructure like collection, bins, disposal facilities, they will be more likely to practice appropriate waste disposal behaviour.

Because the p-value is less than 0.01, we reject the null hypothesis (H_{03}). Therefore, the findings support the conclusion that the availability and accessibility of infrastructure have a statistically significant impact on how residents manage their waste.

This finding is in agreement with some earlier research. Some recent studies have shown the significant impact of waste management infrastructure on residents'

waste disposal practices. According to studies conducted in Logia Town, Ethiopia, families that had access to suitable disposal places for trash were six times more likely to practice appropriate waste management than those that did not. Furthermore, it was determined that the lack of door-to-door waste collection services was a major risk factor for inappropriate waste management practices. This highlights the significance of regular and convenient waste collection services in encouraging appropriate waste disposal practices (Anokye et al., 2024).

Similarly, in Lilongwe, Malawi, limited waste management infrastructure, such as a lack of garbage containers and greater distances to collection locations, increased the likelihood of waste being deposited in public areas and on roadsides (Geninyan et al., 2023). In Lilongwe, Malawi, a lack of waste management infrastructure caused the residents to dump their wastes in public spaces and along the sides of roadways (Geninyan et al., 2023). In the another study, it was noted that less than 30% of the generated garbage waste generated are collected by authorities, leading residents to resort to improper waste disposal practices due to the lack of convenient and regular waste collection services (Kalonde et al., 2023).

Collectively, these studies suggest that there is a relationship between availability and accessibility of waste management infrastructure, including adequate disposal sites and regular collection services waste management practices. Improving infrastructure and ensuring convenient access to waste disposal options are essential steps toward promoting proper waste management practices.

Research Questions 4 and Hypothesis 4: Relationship Between a Combination of Knowledge, Perception, and Infrastructure and Residents' Waste Management

Research Questions: Is there a relationship between a combination of knowledge, perception, and infrastructure and residents' waste management practices?

Hypothesis: There is no relationship between a combination of knowledge, perception, and infrastructure of waste management and residents' waste management practices.

Table 6.

Waste Management Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.513[a]	.263	.257	.08737

Note. a. Predictors: (Constant), log Waste Management Infrastructure, log WASTEMANAGEMENT PERCEPTIONS, log WASTE MANAGEMENT KNOWLEDGE

Table 7.

Waste Management ANOVA

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.970	3	.323	42.378	.000[b]
	Residual	2.717	356	.008		
	Total	3.688	359			

A. Dependent Variable: Log_Waste Management Practices

B. Predictors: (Constant), Log Waste Management Infrastructure, Log Waste Management Perceptions, Log Waste Management Knowledge

Table 8.

Waste Management Coefficients

Coefficients						
		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	T	Sig.
1	(Constant)	.090	.037		2.413	.016
	Waste Management Knowledge	.179	.047	.181	3.782	.000
	Waste Management Perceptions	.107	.042	.117	2.554	.011
	Waste Management Infrastructure	.425	.048	.425	8.883	.000
A. Dependent Variable: Waste Management Practices						

According to the Model Summary, the correlation coefficient (R = 0.513) suggests a relationship between the predictor variables (waste management knowledge, perceptions, and infrastructure) and the dependent variable (waste management practices). The R Square value (0.263) indicates that 26.3% of the variance in waste management practices is explained by these three independent variables combined. The Adjusted R Square (0.257) is slightly lower than R Square, suggesting minimal shrinkage, meaning the model remains a good fit even when adjusted for the number of predictors. The Standard Error of the Estimate (0.08737) represents the average deviation of predicted values from actual values, showing reasonable accuracy.

Table 7, which is the ANOVA table**,** evaluates the statistical significance of the regression model. The F-value (42.378) is substantially high, indicating that the model explains a significant proportion of variance in waste management practices. The p-value (0.000) is well below 0.05, confirming that the overall model is statistically significant. The total sum of squares (3.688) represents the total

variability in waste management practices. The regression sum of squares (0.970) indicates the portion of variability explained by the predictors, while the residual sum of squares (2.717) represents the unexplained variance. These results suggest that knowledge, perceptions, and infrastructure contribute significantly to waste management practices.

Table 8 is the Coefficients table which provides insight into the contribution of each independent variable. The constant value (B = 0.090) represents the baseline level of waste management practices when all predictors are at zero. The regression coefficient for waste management knowledge (B = 0.179) suggests that a one-unit increase in knowledge leads to a 0.179-unit improvement in waste management practices. The waste management perceptions coefficient (B = 0.107) implies that perceptions have a positive but smaller impact compared to knowledge and infrastructure. The waste management infrastructure coefficient (B = 0.425) shows the strongest effect, indicating that improving infrastructure significantly enhances waste management practices. The standardized Beta coefficients reinforce this, with infrastructure having the highest Beta (0.425), followed by knowledge (0.181) and perceptions (0.117). The t-values and p-values confirm that all three predictors significantly contribute to the model ($p < 0.05$).

The findings indicate that waste management infrastructure has the strongest influence on waste management practices (B = 0.425, $p < 0.001$), followed by knowledge (B = 0.179, $p < 0.001$) and perceptions (B = 0.107, $p = 0.011$). The model explains 26.3% of the variance, showing a significant impact of these predictors.

The emphasis laid on the infrastructure agrees with studies as stated above. For instance, Asfaw et al. (2024) found out in Logia Town, Ethiopia, that households with access to proper disposal sites were six times more likely to manage waste

correctly, while the absence of door-to-door collection increased improper disposal. Similarly, in Lilongwe, Malawi, Geninyan et al. (2023) discovered that inadequate infrastructure, such as a lack of garbage containers and distant collection points, led to more waste being discarded in public spaces (Geninyan et al., 2023). Less than 30% of waste is collected by authorities, forcing residents to resort to improper disposal methods (Kalonde et al., 2023). Despite positive opinions about waste management, residents in Durban, South Africa, believed that the city authority was solely in charge of it, highlighting the need for infrastructure and education (Thakur & Onwubu, 2024).

Apart from the focus on infrastructure, other research demonstrates the interconnectedness of perception and knowledge regarding waste management practices. In Sorsogon City, Philippines, a study by Jeremias and Fellizar (2019) evaluated households' solid waste management (SWM) behaviors, knowledge, awareness, and perceptions. The findings showed that although a sizable percentage of respondents had moderate levels of awareness and knowledge, they did not always correspond to efficient SWM practices. Remarkably, 85% of participants sold recyclables and 82% of participants separated their waste, driven by the desire for cleanliness and extra cash. Nevertheless, habits like burning home trash and disposing of trash in waterways continued. The study discovered modest relationships between SWM practices and knowledge, household size, income, age, and educational achievement.

The study stressed that household knowledge have a decisive role in determining waste management strategies and practices. A lack of information and awareness among families was linked to ineffective waste management, contributing to pollution and health concerns. The findings underscore the importance of

understanding community perceptions and behaviors to develop effective educational and awareness campaigns that promote environmentally responsible waste management practices (Ayeleru et al., 2020).

In Port Harcourt Metropolis, Nigeria, a study investigated the determinants of knowledge, attitude, and practices of refuse disposal methods among residents. The findings revealed high levels of knowledge (85%) and positive attitudes (81%) towards refuse disposal. However, only 63% demonstrated moderate practices. Factors influencing refuse disposal included access to waste disposal facilities (88%), cost (55%), peer influence (23%), lack of awareness (48%), and government policies (72%). Significant relationships were found between knowledge and practice, as well as attitude and practice, indicating that while residents possess knowledge and positive attitudes, practical implementation is influenced by infrastructural and policy-related factors (Hassan et al., 2024).

Research Questions 5 and Hypothesis 5: Relationship Demography and Residents' Waste Management

Research Questions: Does the demographic profile moderate the relationship between the independent and dependent variables?

Hypothesis: The Demographic profiles do not significantly moderate the relationship between a combination of knowledge, perception, and infrastructure of waste management and residents' waste management practices.

Table 9.

Demographic Characteristics of Study Participants

Demographic Variable	Categories	Frequency (N=372)	Percentage (%)
Gender	Male	160	43.0
	Female	212	57.0
Age Group	24-28	161	43.3
	29-33	78	21.0
	34-38	40	10.8
	35-39	12	3.2
	40-44	18	4.8
	45-49	39	10.5
	50-54	12	3.2
	55-59	12	3.2
Marital Status	Single	251	67.5
	Married	116	31.2
	Divorced	3	0.8
Educational Level	Elementary	6	1.6
	Junior High	6	1.6
	High School	6	1.6
	Diploma	43	11.6
	BSc/BA	170	45.7
	Master	111	29.8
	PhD	30	8.1
Employment Status	Employed/Working	183	49.2
	Unemployed/Not Working	189	50.8
Type of Occupation	Self-employed	225	60.5
	Running a Business	36	9.7
	Office Job	111	29.8
City	Monrovia	91	24.5
	Paynesville	281	75.5
Monthly Income (USD)	Below 100	217	58.3
	101 – 200	31	8.3
	201 – 300	52	14.0
	301 – 400	19	5.1
	401 – 500	9	2.4
	501 and Above	44	11.8
Community Type	Rich/Affluent Class	81	21.8
	Middle Class	248	66.7
	Low Class	43	11.6
House Type	Fenced	128	34.4
	Unfenced	244	65.6

The gender distribution shows that 57.0% of the sample consists of females, while males account for 43.0%. This slight female majority may suggest that women are more engaged or accessible for surveys on waste management, potentially reflecting their active role in household waste disposal.

The age distribution shows that the majority of respondents (43.3%) fall within the 24-28 age group, followed by 21.0% in the 29-33 category. With nearly 64% of the sample under 34 years, it is evident that young adults form the core of the study. This suggests that waste management strategies should consider youth engagement in awareness campaigns and policy implementation, as they are key drivers of change in environmental practices.

In terms of marital status, a significant 67.5% of respondents are single, while 31.2% are married. The low percentage of divorced individuals (0.8%) reflects a social structure where singlehood and marriage are dominant.

Education levels among respondents are relatively high, with 45.7% holding a bachelor’s degree and 29.8% a master’s degree. Only 4.8% have a high school education or below, indicating that literacy levels in this sample are strong. A high level of education could positively impact waste management practices, as individuals with formal education are more likely to understand and implement proper waste disposal methods.

The employment status data shows that the population is almost evenly split between employed (49.2%) and unemployed (50.8%). The high unemployment rate could influence waste management behaviors, as economic constraints may limit an individual's ability to afford proper waste disposal services. Among the employed, 60.5% are self-employed, while 29.8% hold office jobs and 9.7% run businesses. The

dominance of self-employment suggests a significant informal workforce, which may affect waste generation and disposal behaviors.

The study also reveals that 75.5% of respondents reside in Paynesville, while 24.5% live in Monrovia. This suggests that waste management infrastructure should prioritize Paynesville due to its larger population. Additionally, income distribution shows that 58.3% of respondents earn below 100 USD per month, while only 11.8% earn 501 USD and above. The predominance of low-income earners suggests financial barriers to effective waste management, highlighting the need for affordable waste collection services.

Community class distribution indicates that 66.7% of respondents belong to the middle class, 21.8% live in affluent areas, and 11.6% are in low-income neighborhoods. Variations in waste management practices may arise from these economic differences, as affluent areas are more likely to have structured waste collection systems. Furthermore, housing conditions show that 65.6% of respondents live in unfenced homes, while 34.4% reside in fenced homes.

People who live in fenced homes report better infrastructure access and a more positive perception of waste management, which is in line with expectations because physical barriers like fences are often associated with a sense of security. However, the relationship between demographic variables and knowledge, perception, infrastructure, and practice is complex and not always linear. It is important to recognize that individuals in unfenced homes report slightly higher knowledge levels. This may be attributed to their exposure to wasted. However, practice scores are mostly unchanged for both types of dwelling, indicating that although fences could boost perception and infrastructure, they do not always result in better waste management practices. Notably, compared to their counterparts in unfenced houses,

females who live in fenced homes report better infrastructural and practice outcomes. Males, on the other hand, have minimal differences in results according on the kind of housing.

Gender disparities in perception, infrastructure, practice, and knowledge are still small yet significant. While women showed somewhat higher levels of knowledge, men reported slightly higher perception and practice scores. This can be a reflection of the traditional roles that women have played in the management of waste and other aspects of household choice.

Age disparities also have a big impact on how people manage their waste. The greatest perception and practice scores were obtained by respondents between the ages of 34 and 38, most likely as a result of their active involvement in family and community duties. A possible discrepancy between what is known and what is done was shown by the fact that individuals between the ages of 35 and 39 had the greatest knowledge levels but relatively lower practice scores.

Those with higher former education did not translate their education in to better waste management. The outcome may stem from their greater exposure to lived realities and the necessity of hands-on waste management. Those with junior high education showed the highest levels of practice, indicating that this educational level gives people useful abilities. The highest perception ratings were displayed by diploma holders, which would suggest increased awareness without a commensurate rise in practical application.

Overall, waste management outcomes are obviously correlated with demographic factors like gender, age, education, and housing type; however, these relationships are mediated by intricate and frequently non-linear interactions. These demographic factors, functioning as moderating variables, demonstrate varied

relationships with knowledge, perception, infrastructure, and practice. This indicates the need for nuanced, context-specific approaches to policy and intervention design, as uniform strategies may not adequately address the specific challenges or strengths of different demographic groups.

CHAPTER 5

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

This chapter will summarize the entire work; provide a conclusion and recommendations in line with the findings.

Summary

This study explores the challenges surrounding waste management in Montserrado County, particularly focusing on Monrovia, where the improper disposal of waste remains a persistent problem despite governmental and collaborative efforts. Defined by the United Nations Statistics Division (UNSD) as materials intended for disposal after they have fulfilled their original purpose, waste is a product of virtually all human activities. What qualifies as waste can be subjective, as its categorization depends on the perspective of the generator. Waste management is a complex process that includes waste collection, transportation, processing, recycling, and disposal, and it is central to environmental sustainability, public health, and overall well-being (Qasim & Shareefdeen, 2022). Liberia has witnessed a sharp increase in waste generation, driven by rapid urbanization. Around 50.7% of the population now resides in metropolitan areas, contributing to significant environmental and health concerns such as air pollution, improper waste disposal, and insufficient waste management infrastructure (David Jr. et al., 2020).

Despite efforts by the Liberian Government, in partnership with international bodies like the World Bank and the European Union, to improve waste management

infrastructure, such as the Emergency Monrovia Urban Sanitation Project (EMUS), and Cheesemanburg Landfill Urban Sanitation (CLUS), waste management still remains a challenge. The lack of a thorough waste management system, inadequate regulations for waste generators, and a lack of commitment from decision-makers to guarantee successful implementation are some of the main causes of these difficulties (David Jr. et al., 2020). The agriculture and public health sectors have suffered greatly as a result of this worsening of waste management methods (UNEP, 2024).

With more than 90% of waste being inappropriately disposed of in uncontrolled dumpsites, Montserrado County's waste management continues to pose serious threats to the environment and public health. The study intends to answer a number of important questions on the relationship between knowledge, infrastructure, perception, and waste management practices of residents in Montserrado County. The study also aims to investigate if residents' waste management practices are moderated by a combination of these characteristics and demographic profiles.

A thorough analysis of available literature shows that numerous research have investigated waste management practices in various geographical areas, emphasizing the role that infrastructure, perceptions, and knowledge have in determining waste disposal practices. Sociodemographic characteristics including age, income, education, and gender have been found to have a major impact on waste management practices in nations like Nigeria, Zimbabwe, India, and Kenya (Chikowore, 2020; Emesowum & Chiejina, 2023; Geetha & Rajalakshmi, 2022). Findings from many studies, such as those from Gokarneshwor in Nepal and Ban Khlong Phai in Thailand, indicate that although waste management knowledge is crucial, it is not always enough to promote appropriate practices. The waste disposal habits of residents are greatly influenced by their access to waste management infrastructure, such as regular

services and waste collection locations (Kamweru, 2019; Sherpa & Pathak, 2019). Studies conducted in cities like Nakuru of Kenya, and Lilongwe of Malawi, have shown that insufficient infrastructure often leads to inappropriate waste disposal practices, such as burning or dumping (Geninyan et al., 2023).

Additionally, it has been demonstrated that while public perceptions of waste management policies and practices might affect behavior, they do not necessarily translate into noticeable changes in waste management practices (Anokye et al., 2024; Thakur & Onwubu, 2024). Effective waste management depends not only on governmental regulations but also on proactive community involvement and engagement, according to studies like those conducted in Rwanda (Yeenee et al., 2024). In order to promote better waste management practices, the literature thus emphasizes the significance of a multidimensional strategy that incorporates infrastructure development, education, and efficient policy implementation.

Gap Filled by the Study

By concurrently investigating the relationships among knowledge, perception, infrastructure, and demographic factors, all of which have frequently been examined separately in previous research, this study closes a gap in the literature. Notably, no one has carried out a study of this kind in Liberia; therefore this research is very helpful in comprehending the peculiar difficulties that Montserrado County faces. Prior research has indicated relationship between waste management practices and knowledge, but it has not thoroughly examined the combined influence of both elements, particularly in poor nations like Liberia, where waste management infrastructure and public awareness may be more limited.

In conclusion, this study highlights the necessity of a thorough approach to the management of waste in Montserrado County, one that takes into account the

demographic profiles of the residents, their perception toward waste management regulations, their level of Knowledge, and the accessibility of waste management infrastructure. Furthermore, it emphasizes how important it is to involve communities and provide the infrastructure and policy required to promote sustainable waste management methods. In addition to helping to direct future policy interventions aimed at enhancing waste management in Liberia, the study's findings will add to the expanding body of knowledge on waste management in developing nations.

Conclusion

There is a complex relationship between independents variables and the efficacy of waste management practices, as demonstrated by the evaluation of infrastructure, perception, and knowledge as predictors of waste management practices among selected communities in Montserrado County. The study offers an important information on the relationship between these variables and how they affect waste management practices as a whole.

Firstly, the finding showed that although waste management knowledge was strongly correlated with waste management practices, the effect was small, indicating that it is not enough to significantly alter waste disposal practices on its own. This research emphasizes the necessity of a more all-encompassing strategy that goes beyond raising awareness alone. Waste management practice, however, was not significantly correlated with waste management perception. This suggests that altering perception alone is insufficient to influence practice in waste management.

However, the variable that showed the strongest correlation with waste management practice was infrastructure. It is the main element affecting how waste is managed. According to the study, which found a substantial positive correlation between infrastructure and waste management practices, upgrading waste collection

facilities, such as adding additional public bins and waste treatment systems, is essential to improving waste management initiatives. It further supports this by demonstrating that infrastructure is the most significant predictor of appropriate waste disposal methods, followed by perceptions and knowledge.

The study also looked at how demographic variables might influence waste management practices. There is a complicated and sometimes nonlinear interaction between demographic factors and waste management-related factors, such as knowledge, perception, infrastructure, and practice. While some relationship appear logical and expected, others present surprising nuances that merit closer examination.

In conclusion, the study emphasizes the importance of an integrated approach to waste management in Montserrado County. While enhancing public knowledge and altering perceptions about waste management are important, the most significant improvements in waste management practices will come through increased investment in waste management infrastructure. Addressing infrastructure deficits, along with providing affordable and accessible waste collection services, will lead to more effective and sustainable waste management practices across communities. Furthermore, considering the demographic composition of the population in future waste management strategies will help tailor interventions to the needs of various groups, ensuring broader community engagement and improved environmental outcomes.

Recommendations

Based on the findings of this research, which are leaning toward infrastructure, the following recommendations are proposed:

Table 10.

Study Recommendations

Research Questions	Main Finding	Recommendations
What is the relationship between the level of knowledge of residents and their waste management practices?	Waste management practices and knowledge level have a relationship. The finding shows that residents' participation in appropriate waste management tends to improve as their understanding of waste management grows. Consequently, there is a strong positive correlation between the citizens' actual waste management behaviors and their understanding of waste management.	• The Ministry of Education should incorporate waste management awareness initiatives into school curricula in order to teach students appropriate disposal practices. • Since the MCC and PCC are primarily in charge of managing waste in Monrovia and Paynesville Cities, they should incorporate waste management awareness programs into their activities for the communities and households. • To encourage responsible waste disposal and community cleanup efforts, local community leaders and civil society organizations should organize awareness campaigns.
What is the relationship between residents' perception of waste management practices and their waste management practices in Montserrado County?	The study showed a weak positive correlation between the perceptions of residents' practices. This result indicates that there is no meaningful relationship between how residents perceive waste management and how they manage their wastes.	• Further studies should be done by the researcher other researchers, MCC and PCC to validate this result.
What is the relationship between the availability and accessibility of waste management infrastructure and residents' waste management practices?	The study showed a positive relationship. It suggests that waste management practices of households improve when infrastructure is made more accessible and available to them.	• The Liberian government and municipal authorities should provide more waste collection points, recycling facilities, and disposal systems, especially in underserved areas. • The Monrovia City Corporation (MCC) and Paynesville City Corporation (PCC) should implement regular and efficient waste collection schedules to reduce illegal dumping. • The Environmental Protection Agency of Liberia (EPA) should strictly monitor and penalize individuals and businesses that violate waste disposal laws.
Is there a relationship between a combination of knowledge, perception, and infrastructure and residents' waste management practices?	The results show a relationship between the predictor variables (knowledge, perceptions, and infrastructure) and the dependent variable (waste management practices). The R Square value (0.263) indicates that 26.3% of the variance in waste management practices is explained by these three independent variables	• Since infrastructure has the strongest influence on waste management practices, the study recommend that: the Liberian business community and NGOs should invest in waste recycling initiatives and promote public-private partnerships for sustainable waste management solutions. • The Liberian government should introduce subsidized or low-cost waste disposal options for low-income

Research Questions	Main Finding	Recommendations
	combined. The findings indicate that infrastructure has the strongest influence on waste management practices (B = 0.425, $p < 0.001$), followed by knowledge (B = 0.179, $p < 0.001$) and perceptions (B = 0.107, $p = 0.011$).	communities to encourage compliance with proper waste management practices.
Does the demographic profile moderate the relationship between the independent and dependent variables?	Although there is a correlation between waste management and demographic factors including gender, age, education, and housing type, these relationships are non-linear. As moderating variables, these demographic characteristics show a variety of relationshp to perception, practice, infrastructure, and knowledge.	• The Paynesville City Corporation (PCC) and Monrovia City Corporation (MCC) should design and implement waste management programs tailored to specific demographic groups. • PCC and MCC should utilize demographic profiling in the planning of waste management activities for communities/household.

Suggestions for Future Study

I suggest that future research be done to assess the effectiveness of government waste management infrastructure and their enforcement.

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APPENDICES

APPENDIX A

QUESTIONNAIRE

I am Amelia Joe Zayzay, of the Adventist University of Africa, Kenya. I am pursuing a Master of Public Health. Thank you for agreeing to participate in this questionnaire focusing on the **Assessment of Knowledge, Perception, And Infrastructure as Determinants of Waste Management Practices Among Selected Communities in Montserrado County, Liberia.** Your responses will contribute to a deeper understanding of the knowledge, perception, and practice of household waste for ensuring proper waste management.
Thank you for your time and valuable contribution.

Instruction: Tick () the most applicable and fill in the blank spaces

SECTION A: DEMOGRAPHIC PROFILE
This section asks for details on yourself which will help me classify your answers.
1. **Gender:** Male [ ] Female [ ]
2. **Age:** 19-23 [ ] 24-28 [ ] 29-33 [ ] 34-38 [ ] 35-39 [ ] 40-44 [ ] 45-49 [ ] 50-54 [ ] 55-59 [ ] 60 and Above [ ]
3. **Marital Status:** single [ ] Married [ ] Divorced [ ] Widowed [ ]
4. **Educational level completed:** none [ ] Elementary [ ] Junior High [ ] High School [ ] Diploma [ ] BA/B.Sc [ ] Master [ ] Ph.D [ ] Medical Doctor [ ] Lawyer [ ] Others, Please Specify _____
5. **Employment status:** Employed/Working [ ] Not Employed/No Working
6. **Type of Occupation:** Self-employed [ ] Running a Business [ ] Office Job [ ]
7. **City**: Monrovia [ ] Paynesville [ ]
8. **Community:** _____
9. **Monthly Income**: **Below 100 USD [ ]** 101USD – 200 USD [ ] **201USD – 300USD [ ]** 301USD – 400USD [ ] **401USD-500USD [ ]** 501USD AND ABOVE [ ]
10. Community Type: Rich/Affluence Class [ ] Middle Class [ ] Low Class [ ]
11. House Type: Fence [ ] Unfence [ ]

SECTION B: Waste Management Knowledge
Please Tick the Appropriate Box
SD= **Strongly Disagree** D= **Disagree** N= **Neutral** A= **Agree** SA= **Strongly Agree**

STATEMENT	SD	D	N	A	SA
Waste Sorting, recycling, compositing:					
I know how to separate recyclable materials from non-recyclables. For example, separating papers from plastic.					

I know how to convert some of my waste to fertilizer or other usable matter. For example, organic kitchen scraps, leaves, and crop residues can be composted to create nutrient-rich soil.					
I know how to convert my waste materials into new products. For example, turning used water plastic bottles into new oil bottle					
Waste Reduction Strategies:					
I know that it is better to use reusable bags instead of single-use plastic bags. For example, using cloth bag to buy my goods instead of plastic bag.					
I know that it is better to use reusable containers instead of single-use plastic bottles. For example, using a stainless-steel water bottle instead of buying bottled water.					
Waste Disposal Methods:					
I know about burying waste in the ground. For example~~,~~ the PCC/MCC/Community buries the waste collected from households and businesses in a specified place.					
I know about burning waste in order to reduce its size. For example, burning household waste, including paper, leaves, and plastic, to clear space and manage trash					

SECTION C: Waste Management Perception
Please Tick the Appropriate Box
SD= **Strongly Disagree** D= **Disagree** N= **Neutral** A= **Agree** SA= **Strongly Agree**

STATEMENT	SD	D	N	A	SA
Economic Consideration/Expensive:					
I feel that buying dustbins to take care of waste is expensive.					
I feel that paying people to come and collect waste is a waste of money.					
Government's Responsibility:					
I feel that it is the responsibility of MCC/PCC to collect waste irrespective of where we drop them.					
I feel that it is the job of MCC/PCC to collect our waste regularly and ensure it is properly disposed of.					
Environmental Health Impact:					
I feel that the dumpsite in my community is producing flies, mosquitos and cockroaches that are making us sick.					
I feel that the dumpsite in my community is polluting our air causing us to get sick.					
Personal Health Impact:					
I feel that waste kept in our dustbin for long is producing flies, mosquitos and cockroaches that are coming back in my house and causing us health challenges.					
I feel that the dumpsite in my yard is causing air pollution for me.					

SECTION D: Waste Management Infrastructure
Please Tick the Appropriate Box
SD= **Strongly Disagree** D= **Disagree** N= **Neutral** A= **Agree** SA= **Strongly Agree**

STATEMENT	SD	D	N	A	SA
Waste Collection Services:					
Paynesville City Cooperation/Monrovia City Cooperation agents come to collect my wastes every time for fee/free.					
I pay someone/private organization to collect my waste every time.					
Recycling Facilities:					
There are several places nearby where I can drop off cans and bottles to be recycled.					
I have special area in my house/yard for sorting waste materials for recycling.					
Waste Disposal Facilities:					
I have dustbin in the house for throwing wastes.					
I have a pit/hole in my yard to dispose my waste.					
The community/government has provided or designated certain areas for emptying out dustbins.					
Regulatory Framework/Policy:					
Paynesville City Cooperation/Monrovia City Cooperation /Government has laws on where to throw waste.					
Paynesville City Cooperation/Monrovia City Cooperation /Government fines people for throwing waste anywhere.					

SECTION E: Waste Management Practices
Please Tick the Appropriate Box
SD= **Strongly Disagree** D= **Disagree** N= **Neutral** A= **Agree** SA= **Strongly Agree**

STATEMENT	SD	D	N	A	SA
Waste Sorting, recycling, compositing:					
Individual/household					
I do separate papers waste from my plastic waste and dust waste.					
I turn things that are old and useless into useful things like reusing my worn-out/old t-shirts or cloths to clean my floor; and turning used water plastic bottles into new oil bottles to keep my oil.					
Community					
MCC/PCC [other paid entities] separate the community waste that we gather at a specific place before transporting them.					
MCC/PCC or other paid entities use the community waste for different purposes such as agriculture.					
Waste Reduction Strategies:					
Individual/household					

I do use cloth bag to buy my goods instead of plastic bags which are difficult to dispose/decay whenever I go to the market.					
I clean our food (fish, meat, greens, etc) in the market instead of bringing them home.					
Community					
MCC/PCC [Government] is discoursing us to use plastic products.					
Waste Disposal Methods:					
Individual/household					
I do bury the waste collected from the household in a specified place.					
I do burn waste to reduce its size.					
Community					
MCC/PCC or other paid entities collect the community waste that we gather at a specific place.					
MCC/PCC or other paid entities take the community waste to a a specific place for burning or disposal to reduce the size.					

APPENDIX B

INFORMED CONSENT FORM

Greetings Friend. I am Amelia Joe Zayzay, of the Adventist University of Africa, Kenya. I am pursuing a Master of Public Health. I request your participation in a study entitled "Assessment of Knowledge, Perception, and Infrastructure as Determinants of Waste Management Practices Among Selected Communities in Montserrado County, Liberia."

The information below tells you about what is involved in the research, what you will be asked to do, and the potential risks and benefits of participating in this study. You are encouraged to ask questions and seek clarification about the nature of the study. Please note that choosing whether to participate in this research is voluntary and entirely your choice. You may refuse to participate or discontinue your participation at any time during the study without any penalty.

The purpose of this study is to evaluate how an individual's or household's knowledge, perception, and infrastructure regarding Waste Management affect their waste management practices.

Your participation: You will be asked to participate in a survey. This means you will be asked to voice your views, opinions, or experience about Knowledge, Perception, and Infrastructure as Determinants of Waste Management Practices Among Selected Communities in Montserrado County, Liberia. The survey will take about 10 minutes to complete.

Benefits and Risks: If you participate, you will contribute to knowledge about waste management in Montserrado, which may help to improve citizens' view of waste.

Confidentiality: Your personal information will be kept confidential. Your survey responses will be anonymized so they will not be identified in any report or publication of this study.

Please carefully read and sign this Form if you are willing to participate in the study.

My participation in this research project is voluntary. There is no explicit or implicit coercion whatsoever to participate.

I may withdraw and discontinue participation at any time without penalty.

I understand that if I feel uncomfortable during the survey, I have the right to decline to answer any question or end the survey.

I understand the researcher will not identify me by name in any reports using information from this survey.

If you have any ethical concerns about your participation in this research, contact the Institutional Scientific Ethics Review Committee, Adventist University of Africa <ethics@aua.ac.ke>

I have read and fully understood the statements on this Form. All my questions were answered satisfactorily. I voluntarily agree to participate in this study.

Participant's Signature: _____ Date:

Researcher's Signature: _____ Date:
Contact the supervisor of the research if you need more information or have questions: Dr. Janet Nyaboke Odhiambo, +254745621247
Thank you.
Amelia Joe Zayzay, MPH, 0778078293

APPENDIX C

ETHICS REVIEW LETTER

Adventist University of Africa
Developing Leaders for Service
A Private Chartered University Accredited by Commission for University Education, Kenya

10th March 2025

Amelia Joe Zayzay
School of Postgraduate Studies
Adventist University of Africa
Kenya

Reference: AUA/ISERC/19/02/2025

Dear Amelia Joe Zayzay

RE: Assessment of Knowledge, Perception, and Infrastructure as Determinants of Waste Management Practices among Selected Communities in Montserrado County, Liberia

This is to inform you that the Adventist University of Africa Institutional Scientific Ethics Review Committee (AUA-ISERC) has reviewed and approved your research proposal titled above. Your application approval number is AUA/ISERC/2025/012. The approval period is 10th March 2025 – 9th March 2026.

This approval is subject to compliance with the following requirements:

i. Only approved documents (including informed consent and study instruments) will be used.
ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by AUA-ISERC.
iii. Death and life-threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to AUA-ISERC within 72 hours of notification.
iv. Any changes, anticipated or otherwise that may increase the risks or affect the safety or welfare of study participants and others, or affect the integrity of the research must be reported to AUA-ISERC within 72 hours.
v. Submission of a request for renewal of approval at least 60 days prior to the expiry of the approval period. Attach a comprehensive progress report to support the renewal.
vi. Submission of an executive summary report within 90 days upon completion of the study to AUA-ISERC.

Prior to commencing your study, you are expected to obtain permissions or any other clearances needed.

Yours Sincerely

Josephine Ganu, Ph.D.
Chair, Institutional Scientific Ethics Review C'ttee
ethics@aua.ac.ke

ADVENTIST UNIVERSITY OF AFRICA
ETHICS REVIEW COMMITTEE
PRIVATE BAG MBAGATHI - 00503,
NAIROBI - KENYA

APPENDIX D

STATISTICAL DOCUMENTS

Notes on the Relationship Between Waste Management Knowledge and Waste Management Practices

Output Created		17-APR-2025 02:15:03
Comments		
Input	Data	C:\Users\gross\Documents\Untitled4.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	372
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each pair of variables are based on all the cases with valid data for that pair.
Syntax		CORRELATIONS /VARIABLES=log_Waste Management Knowledge log_Waste Management Practice /PRINT=TWOTAIL NOSIG FULL /MISSING=PAIRWISE.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.03

Notes on the Relationship Between Perception and Waste Management Practices

Output Created		17-APR-2025 02:21:52
Comments		
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	Filter	<none>
	Weight	<none>
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Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each pair of variables are based on all the cases with valid data for that pair.

Syntax		CORRELATIONS /VARIABLES=log_ Waste Management Perception log_ Waste Management Practice /PRINT=TWOTAIL NOSIG FULL /MISSING=PAIRWISE.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.04

Notes on the Relationship Between Infrastructure and Waste Management Practices

Output Created		17-APR-2025 02:22:38
Comments		
Input	Data	C:\Users\gross\Documents\Untitled4.sav
	Active Dataset	DataSet1
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	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	372
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each pair of variables are based on all the cases with valid data for that pair.
Syntax		CORRELATIONS /VARIABLES=log_ Waste Management Infrastructure log_ Waste Management Practice /PRINT=TWOTAIL NOSIG FULL /MISSING=PAIRWISE.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.06

VITA

Name	Amelia Joe Zayzay
Date of Birth	May 22, 1988
Email	zayzaya@auwa.edu.lr zayzaya@aua.ac.ke
Contact	+231778078293 +231886653048
Nationality	Liberian
County of Origin	Bong County
Tribe	Kpelleh
Marital Status	Married to Emmanuel Forkpa Zayzay Jr.
Children	Emmanuel Numennue Zayzay
Guidant to	Abigail Lorpu Tokpah Henry Body Yarkpawolo
Height	5.5 Feet
Completion	Dark

EDUCATIONAL BACKGROUND

Bachelor of Science in Public Health	2018 Adventist University of West Africa Schiefflin Township Margibi County, Liberia

WORKING EXPERIENCE

Administrative Assistant, Presidency	2018 - Present Adventist University of West Africa Schiefflin Township Margibi County, Liberia
Teacher	2013-2014 Paynesville Adriel Academy ELWA Junction Paynesville City, Liberia
Temperature Tester	2015 Celcom Telecommunication Company Capital Bypass, Monrovia, Liberia

ACADEMIC CONFERENCES ATTENDED

Titles	Publication Details
Adventist University of West Africa Multidisciplinary Conference 2019	Attendee
Adventist University of West Africa Multidisciplinary Conference 2021	Attendee
Adventist University of West Africa Multidisciplinary Conference 2024	Attendee