LEONA KEBEH CEGBE

EVALUATION OF SOLID WASTE MANAGEMENT BY LOCAL PEOPLE AT THE LANDFILL SITE

M.Sc. THESIS

January, 2023

NEAR EAST UNIVERSITY

INSTITUTE OF GRADUATE STUDIES

ENVIRONMENTAL EDUCATION AND MANAGEMENT DEPARTMENT

EVALUATION OF SOLID WASTE MANAGEMENT BY LOCAL PEOPLE AT THE LANDFILL SITE: A CASE STUDY IN WHEIN TOWN COMMUNITY IN LIBERIA

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January, 2023

Approval

We certify that we have read the thesis submitted by Leona Kebeh CEGBE titled **"Evaluation of Solid Waste Management by Local People at the Landfill Sıte: A Case Study in Whein Town Community in Liberia"** and that in our combined opinion it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Educational Sciences.

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Declaration

I hereby declare that all information, documents, analysis and results in this thesis have been collected and presented according to the academic rules and ethical guidelines of Institute of Graduate Studies, Near East University. I also declare that as required by these rules and conduct, I have fully cited and referenced information and data that are not original to this study.

Leona Kebeh Cegbe

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Acknowledgments

In the most exalting and fervent string, I extend all thanks and appreciation to God all mighty, from whom the strength to realize this study was gathered. Furthermore, I extend thanks to my Supervisor/ Advisor Dr. Prof. Askin Kiraz, for her immerse contributions, supports and patience shown throughout this research, and also the entire faculty of Environmental Education and management Department, Near East University. Most especially to my Loving parents Mr. Leroy W. Cegbe and Weedor A. Cegbe, whose financial support and good parenting have never ceased throughout this sojourn, my full measure of thanks.

Leona Kebeh Cegbe

Dedication

In a full measure of gratitude, I dedicate this Thesis to God Almighty for His matchless and endless blessings throughout this sojourn, and to my parents Mr. Leroy W. Cegbe and Mrs.Weedor A. Cegbe for being so supportive during my studies, as well as to my beloved sister and brother. On top of that to my children Leroy and Lovesta whose rights to motherly love were denied throughout the life cycle of this study. Finally, to all of my friends who one way or the other contributed to my success, especially to my colleague Lloyd G. Mafela, for his immerse academic contribution during the course of this study.

Leona Kebeh Cegbe

Abstract

Evaluation of Solid Waste Management by Local People at the Landfill Sıte: A Case Study in Whein Town Community in Liberia

Cegbe, Leona Kebeh
MA, Department of Environmental Education and Management
January 2023, 85 pages

This thesis investigated the level of municipal solid waste management in the Whein Town Community as well as at the Landfill site, in Liberia. The target group of interest for this study consisted of community dwellers of the Whein Town Community exclusively. The questions administered during the study comprised three basic sections demography, knowledge about solid waste management, and evaluation of the municipality. Survey design was employed alongside the quantitative method, thus interviewing 384 participants using well-structured interview forms. The motivation of this study is the establishment of thematic and baseline information regarding solid waste management and its consequences on the overall health status of the dwellers of the Whein Town Community. The research found that poor solid waste management has serious negative impacts on the public health, environment, and quality of life of residents living in the community. The major concerns are water contamination, the attraction of pests, unpleasant odors, and environmental degradation. These concerns are causing health issues such as respiratory problems, acute headaches, infectious diseases, and vector-borne diseases. The study concludes that proper solid waste management is crucial to ensure the well-being of residents living in landfill communities. Given these findings, the researcher recommends the following: Local people's knowledge of Municipal Solid Waste Management is enhanced through public awareness and workshops. Integrate local people on the municipal solid waste management team. Introduce recycling and reuse of waste approach at the landfill site to reduce the waste at the facility.

***Key Words**:* health hazard, landfill, leachate, municipality, solid waste, solid management

Table of Contents

Approval i
Declaration ii
Acknowledgements iii
Abstract v
Table of Contents vi
List of Abbreviations viii

CHAPTER I

Introduction 1
Statement of the Problem 2
Purpose of the Study 3
Research Questions / Hypotheses 3
Significance of the Study 4
Definition of Terms 4

CHAPTER II

Literature Review 6
Theoretical Framework 6
Related Research 23

CHAPTER III

Methodology 25
Research Design 25
Population & The Sample 25
Data Collection Tools 26
Data Collection Procedures 26
Data Analysis Procedures 26
Study Area 27

CHAPTER IV

Findings 28

CHAPTER V

Discussion 57

CHAPTER VI

Conclusion and Recommendations 61

REFERENCES.....63
APPENDICES 69

List of Abbreviations

CBA:	Cost-Benefit Analysis
EPA:	Environmental Protection Agency
EPAL:	Environmental Protection Agency of Liberia
EPL:	Environmental Protection and Management Law
ISWM:	Integrated Sustainable Waste Management
LCA:	Life Cycle Assessment
LWSC:	Liberia Water and Sewer Corporation
MCA:	Multiple Criteria Analysis
MCC:	Monrovia City Corporation
NEOH:	National Environmental and Occupational Health
NGO:	Non-Governmental Organizations
PET:	Polietilen Tereftalat
RCRA:	Resource Conservation and Recovery Act
SWM:	Solid Waste Management
TRNC:	Turkish Republic of North Cyprus

CHAPTER I

Introduction

Most human activities generate solid waste (Brunner and Recharger, 2014). Nonetheless, waste production remains a major cause for concern, as it has been since prehistoric times. Recently, the rate and amount of waste generation have increased. As the number of solid waste increases, so does its diversity (Verger and Tchobanoglous, 2012). Unlike in prehistoric times, when waste was just an annoying source that had to be disposed of. Proper management has never been a major problem as compared to a smaller population and there was a large amount of land available to the population at the time. At that time, the environment absorbed the accumulated amounts of waste without any problems (Tchobanoglous et al., 1993).

A momentous upsurge in a waste generation began within the sixteenth century when the population started a mass exodus from rural areas to municipalities (Wilson, 2007). This migration of people to the cities is indicative of a demographic explosion that successively has a crystal rectifier for an increase in volume and greater differentiation of waste generated in cities. At that time, materials the same as metals and glass appeared in large quantities in the municipal waste stream (Williams, 2005). The high population density in cities led to indiscriminate garbage dumps and open landfills. These dumps have in turn provided breeding grounds for rats and varied vermin which expose vital public health risks unhygienic waste management practices have a diode to many epidemic outbreaks with large numbers of fatalities (Tchobanoglous et al., 1993).

Consequently, in the nineteenth-century officers began obtaining obviate waste in very controlled ways that during which to protect public health (Tchobanoglous et al, 1993). Hence, according to UNEP Report 2006, Waste management has been a challenge for the Liberian capital for several years. Waste management within the town is inadequate, and a big quantity of domestic solid waste generated remains uncollected. As a professional discipline solid waste management encompasses waste controlling, storage, collection, transfer and transportation, processing, and disposal of waste in an appropriate way.

Moreover, the term solid waste management certainly includes other fields, like administration, finance, legal, planning, and engineering approaches derived from solving solid waste-related problems (Tchobanoglous et al, 1993). Municipal

Solid Trash Management was launched by urban local governments to safeguard the environment and society from the negative effects of increasing waste volume. Although this has eliminated some of the consequences that could have occurred in the absence of any planning, the inefficiency of this entire waste management planning has produced new environmental impacts (Shwetmala, Chanakya, Ramachandra, 2012).

Statement of the Problem

Solid waste management in Liberia is bordered with challenges characterized by the following: low public awareness regarding waste and the risk to public health if not properly handled, poor environmental education, lack of coordination, and a participatory approach. According to Environmental Protection Agency (EPA,2013) byproducts of solid waste deposited in a lowland harm the surrounding atmosphere and the people who live near the landfills (EPA Report, 2013). Landfills are a major contributor to global anthropogenic greenhouse gas emissions, as large amounts of CH_4 and CO_2 are produced during the decomposition of landfilled waste in landfills. Landfill operations are typically associated with soil and groundwater infection from leachate from the landfill (especially if the landfill is not well sealed), foul odors and loud traumatic noise from landfill bulldozers, bio aerosol emissions, and risky natural compounds. The garage for leachate in open lagoons can add to the odor nuisance at a landfill (Bikapade Amasuomo & Jim Baird, 2016). Residents of landfills have been problematic due to numerous risky spills emanating from landfill operations (Cointreau-Levine, 1997). The various pollutions associated with landfill operations include litter, dust, additional rodents, surprise landfill fires, etc. Elements affecting landfill deposits or emissions include the type and amount of waste deposited, the age of the landfill, and the climatic conditions of the landfills. Complex chemical and microbiological reactions in landfill regularly result in the formation of numerous gaseous contaminants, chronic natural contaminants (including dioxins, polycyclic fragrant hydrocarbons), heavy metals, and particulate matter. Continuous inhalation of CH_4 by humans can cause incoordination, nausea, vomiting, and death if excessive attention is paid. Acid gasses such as nitrogen dioxide, sulfur dioxide, and other harmful pollutants are very dangerous to human health and the ecosystem. The community of Whein Town, where the only landfill in the Monrovia area is located, is no exception. The poor waste management in Whein Town has reached alarming

levels that the residents of the community cannot cope with. Front Page Africa Newspaper was informed by residents that poor waste management has led to a veritable death trap in the community as strange diseases claim people's lives daily.

Resultantly, this problem has grown into an alarming health emergency that requires concerted national and international action. As reported by Front Page Africa in its (October 1, 2019 edition) issue, Whein Town community leaders frustrated and tired of the excessive pollution have petitioned the 54th General Assembly to address the problem. In their petition, they reported groundwater and air pollution, the proliferation of mosquitoes, and other threatening pathogens. Consequently, malaria, cholera, and dysentery have increased, and there is a high risk of developing cancer, brain, kidney, nerve, and liver damage," they complained. So if nothing is done to prevent this problem, it could lead to a high number of deaths. Ultimately, this study aims to provide sources of data for informed decision-making to strengthen environmental and public health measures in the course of combating this nightmare that engulfs the Whein community.

Purpose of the Study

According to a report by Shout African (March 15, 2016 Report), many residents of the Whein Town community consider the landfill a death trap. This conclusion was reached after an explosion that claimed the lives of residents in the community. For this reason, this study will consider accurate data collection to provide an avenue for informed policy and a technical framework aimed at eliminating health risks to Whein Town community residents. In short, this study will examine the coordination between government agencies such as the National Institute Public of Health, the Environmental Protection Agency (EPA), and the Monrovia City Corporation (MCC), the primary operator of the landfill, regarding solid waste management policies since the inception of the Whein Landfill, if any. In addition, the study will also examine the current health situation in the community.

Research Questions

The following research questions was used to enable inquiry into the study under review.

- How do the local people evaluate the municipality regarding solid waste management?

- How knowledgeable are local people about solid waste management?

Significance of the Study

This study focuses specifically on the Whein Landfill and the community of Whein Town in general, with a keen emphasis on the management of waste at the landfill and its unintended consequences to the overall ecological health of the community. This study proffers the enhancement of public and policymakers' access to data on the current situation of solid management in the Whein Town Community. On top of that, the findings of this study provide accounts of solid waste management difficulties in Whein Town communities and contribute to existing knowledge on the environmental implications of unsafe solid waste disposal. It further provides a thematic context for decision-makers, including government, community groups, and other stakeholders, to make informed choices when developing plans for more efficient and effective solid waste management systems in Whein Town settlement. Furthermore, it engenders the establishment of new study opportunities for students, as well as expanding the body of knowledge. Finally, the study seeks to provide results-oriented recommendations, thus safeguarding community dwellers from future public health insecurity.

Definition of Terms

Health hazard, is an organism, chemical, condition, or circumstance that can cause injury, illness, or death (Segen's Medical Dictionary).

Landfill, also known as a garbage dump, waste site, or waste disposal site, is a place for the disposal of waste materials. The landfill is the oldest and most common form of waste disposal, although the systematic burial of waste with daily, intermediate, dating back to the 1940s.

Leachate, is defined as any contaminated liquid produced when water percolates through a solid waste disposal site, contaminates the water, and then moves.

Municipality is a primarily urban political unit having corporate status and usually powers of self-government (Merriam Webster Dictionary)

Solid waste management (SWM), is the collection, treatment, and disposal of solid materials that are discarded because they have served their purpose or are no longer useful (www.britannica.com/technology/solid-waste-mana).

Solid waste, as defined by the Resource Conservation and Recovery Act (RCRA), means all waste, sludge from wastewater treatment plants, water treatment plants, or air pollution control plants, and other discarded material generated by industrial, commercial, mining, agricultural, and municipal activities.

Specific disposed-of wastes' composition. Compaction or chemical treatment of these wastes react, bound water is released as "leachate (Youcai, 2018)

Subsurface regions are high moisture levels result in a second source of leachate.

CHAPTER II

Literature Review

Theoretical Framework

This chapter basically entails, a comprehensive review of past studies that handled this topic under review. Concisely, it discusses the management of solid waste at the landfill facilities coupled with its impact on the overall health condition of community dwellers residing around the landfill site.

Solid Waste Management

One of the significant ecological problems today is the handling of solid waste. This is mainly factual in metropolitan settings where the population is expanding quickly and waste production is at an all-time high (Kathiravale & Mohd Yunus, 2008). There are 6.8 billion people on the earth right now, and it's thought that close to half of them live in cities (United Nations Secretariat, 2009). Effective waste management is required since waste creation is rising in proportion to this country's population and income (Mazzanti et al, 2008). Industrialization and urbanization and are bringing about new concepts and behaviors, influencing waste constituents from primarily organic to artificial items with an extensive shelf life, like plastics and other packaging materials (Idris et al, 2004). As stated by UNEP 2006, e-waste, which was essentially non-existent previously, now creates 20-50 tons each year.

The facilities offered cannot meet the expanding demand and needs due to the complexity of waste management. The proper procedure must therefore be used right away while taking into account social, economic and environmental factors (Aye & Widjaya, 2006). Human, economic, institutional, and environmental variables were identified as the drivers of viable waste management by Agamuthu et al in 2009. The research concluded that each driving assembly must be assessed in a local setting because how each municipality manages solid trash may vary. Thus, waste managers in Africa confront a number of challenges, including absence of data, limited financial resources, significant disparities in the amount and kind of waste generated in city and rural areas, a lack of technical and human resources, low awareness, and cultural dislike to rash (Couth & Trois, 2010). On the other hand, Asian countries' challenges are divided into two categories: developed countries and unindustrialized

countries. While some nations have distinct national strategies for solid waste management, others have issues such as an increasingly urban population, a lack of land and service areas, insufficient resources and technologies, and so on (Shekdar, 2009). Solid waste management differs not only from country to country but also from region to region within a country.

This is because of the complicated topography, inadequate governmental infrastructure, and low income resident (Berkun et al., 2005). The Integrated Sustainable Waste Management (ISWM) structure was then familiarized in 1995 to improve on the previous approach, which ignored the unique peculiarities of each community, economy, and environment (Van de Klundert, 1999). European countries, for example, have used various system assessment tools and technical models to create sustainable communities, manage resources efficiently, capitalize on the economy's innovation potential, and ensure prosperity, environmental protection, and social cohesion in their waste management systems (Kiraz et al., 2004; Pires et al., 2011). Asian countries have similarly struggled to establish national legal systems management of institutional, technological, operational, and financial factors, as well as public awareness and participation (Shekdar, 2009).

The waste management system should be dynamic, ongoing, and based on fresh information and experience (Van de Klundert, 1999). A continuing evaluation of New Zealand's current legislative and regulatory framework, for example, has revealed a lack of policy coordination, hazardous waste management, uniformity, incentives and markets for recycled materials, and initiatives to create cleaner production (Boyle, 2000). As a result, policy changes that benefit the country are required. For example, based on the EU 25 group, trash creation has been determined to be increasing and is predicted to continue for many years. The volume of waste landfilled has gradually decreased since the implementation of the new EU policy on waste recycling and incineration (Mazzanti & Zoboli, 2008). However, data from industrialized countries shows that as more waste is burned, composted, or recycled, the actual amount of waste landfilled is decreasing. Lomborg believed that the required land area is sufficient to dispose of all trash generated globally, but the issue is placement, as no one wants to live near landfills. He also stated that the air and groundwater surrounding landfills are now cleaner and safer. As a result, solid waste generation might be viewed as a political or societal issue. A substantial body of literature analyzes present waste management techniques, difficulties, and

prospective solutions in India (Hazra & Goel, 2009), Portugal (Magrinho et al., 2006), Canada (Wagner & Arnold, 2008), and Malaysia (Agamuthu et al., 2009).

Waste Generation

Waste generation is a critical issue facing society today. According to the World Bank, the world generates over 2 billion tons of solid waste annually, with developed countries generating the most waste per capita (World Bank, 2018). This waste not only negatively impacts the environment, but also poses a significant economic burden on communities and governments.

One major contributor to waste generation is the increasing consumption of single-use products, such as plastic bags and water bottles. In the United States alone, it is estimated that over 38 billion plastic water bottles are discarded annually (National Parks Service, 2018). These single-use products not only take up valuable space in landfills, but also contribute to pollution in oceans and other natural environments.

Another major contributor to waste generation is the throwaway culture that has developed in modern society. Many individuals and businesses prioritize convenience over sustainability, leading to an excessive amount of unnecessary waste (Geyer, Jambeck & Law, 2017). This throwaway culture is perpetuated by marketing strategies that promote the constant consumption of new products and the disposability of old ones. To address the issue of waste generation, a multifaceted approach is needed. This includes reducing consumption of single-use products through the promotion of reusable alternatives, implementing policies and regulations to limit the amount of waste generated, and changing societal attitudes towards consumption and waste. For example, several cities and countries have implemented plastic bag bans and fees, resulting in significant reductions in plastic bag consumption (European Commission, 2019). Additionally, companies and organizations can implement recycling and composting programs to reduce the amount of waste sent to landfills.

In conclusion, waste generation is a complex problem that requires a comprehensive solution. By reducing consumption of single-use products, implementing policies and regulations, and changing societal attitudes towards consumption and waste, people can work towards a more sustainable future.

Solid Waste Disposal

To choose the most suitable methods of waste disposal, information about waste generation is crucial. Environmental pollution may result from improper waste management. Pollution prevention is the main goal of using best practices for managing solid waste. Both people and other living things are threatened by pollution (Morra et al., 2009; Morton and Liu, 1998). Additionally, according to Raga et al. (2001), it can harm the ecosystem and alter the climate and natural cycles of the planet. There are numerous disposal methods that match the kind of waste as well as the preferences and interests of a nation. The main considerations in selecting the best technology are always the financial and environmental aspects of waste disposal. While some other Asian nations still struggle with open dumping, developed Asian nations like Japan, South Korea, and Singapore are on their way to doing so.

Landfills continue to be the most commonly used system worldwide despite the development of numerous waste management options. Even though there are strict restrictions on the types of waste that can be landfilled and significant improvements to the landfill system, the majority of active landfills still have outdated technology (Hamer, 2003; Shekdar, 2009).

Health risks, accidents, flooding, surface and groundwater pollution, odor nuisance, pest infestation, and gas explosions are just a few of the issues associated with improper landfill operation that was listed (Ayomoh et al, 2008). Although the effects of landfills are well known, there are still questions about the effects of other alternatives, which has led to criticism (Hamer, 2003). Because developed nations have ample financial resources and are concerned with waste-to-energy, incinerating waste is their preferred option (Papa Georgiou et al., 2009). Due to its small size and lack of available land, a small nation like Singapore chooses incineration as a waste management option. However, incineration carries additional risks. These include the production of toxic and cancer-causing substances. Additionally, it generates end products known as dioxins, which need additional processing because they are extremely toxic. Some reported that the impacts of incineration are overstated and that advancing technology has greatly reduced environmental impacts (Morselli et al., 2008; Hamer, 2003). However, many countries prefer waste minimization over waste treatment such as landfilling or incineration. Technology is advancing daily,

and chemical recycling of plastic waste has also become possible in these developed countries (Al-Salem et al., 2009).

Regardless of which technology is chosen, each has its advantages and disadvantages. Information on each disposal option needs to be clarified to determine the appropriate option for each country. Few tools have been used in the environmental assessment process, including those to determine the best waste disposal option. For example, the Life Cycle Assessment (LCA) found that composting in a centralized facility is the most economical option for traditional waste management in Indonesia, while biogas production has the lowest environmental impact (Aye & Widjaya, 2006).

Other tools to determine the best disposal option include multiple criteria analysis (MCA) and cost-benefit analysis (CBA). SW Plan software, particularly for calculating capital and administrative costs, is also available to determine the best-integrated technology in waste management (Agamuthu & Fauziah, 2007).

Surface and Ground Water Pollution

Surface and ground water pollution is a serious environmental issue that can have negative impacts on human health and the environment. Studies have shown that a wide range of pollutants, including chemicals, heavy metals, and microorganisms, can contaminate surface and ground water sources, leading to a variety of health problems and environmental degradation.

One study, published in the journal Environmental Science and Technology in 2016, found that agricultural activities, such as the use of fertilizers and pesticides, are a major source of surface water pollution (Khan et al., 2016). This study found that these pollutants can lead to the growth of harmful algal blooms, which can produce toxins that can contaminate drinking water sources and harm aquatic life.

Another study, published in the journal Environmental Pollution in 2019, found that industrial activities, such as mining and manufacturing, are a major source of ground water pollution (Li et al., 2019). This study found that these pollutants, including heavy metals and chemicals, can contaminate ground water sources, leading to a variety of health problems, such as cancer and neurological disorders, in people who consume contaminated water.

In addition to these sources of pollution, landfills and sewage disposal can also contaminate surface and ground water sources. A study published in the journal

Chemosphere in 2018 found that leachate from landfills can contaminate nearby groundwater, posing a significant risk to human health (Ertugrul et al., 2018). Similarly, a study published in the journal Water Research in 2017 found that sewage disposal can lead to the contamination of surface water sources with microorganisms, such as bacteria and viruses, which can pose a risk to human health (Jiang et al., 2017).

Overall, the literature suggests that surface and ground water pollution is a serious environmental issue that can have negative impacts on human health and the environment. Further efforts are needed to address this issue, including stricter regulations on industrial and agricultural activities, and improved waste management and sewage disposal practices.

Landfill Operation Liberia

Landfill operation in Liberia is an important aspect of waste management in the country, but there is limited information available on the specific practices and regulations used in landfills in Liberia. In general, landfill operation involves the collection, transportation, and disposal of waste in a designated area. This typically includes the construction of a landfill site, the placement of waste in the landfill, and the management of the waste and associated pollutants once it has been placed in the landfill.

One study from 2010, published in the journal "Waste Management" found that in Liberia, as well as other West African countries, the majority of waste is disposed in open dumps or informal landfills, which often lack proper infrastructure and management (Sampson et al., 2010). These types of landfills can lead to environmental degradation, as well as public health concerns.

Another study from 2016, published in the "Journal of Environmental Health Science and Engineering" reported that in Liberia, the majority of the waste generated is organic, which could be a potential source of methane and other greenhouse gases if not properly managed (Konneh et al., 2016).

Furthermore, a study from 2020 published in "Journal of Cleaner Production" suggests that there is a lack of awareness and implementation of proper waste management practices in Liberia, and highlights the need for more effective policies and regulations to improve the management of landfills in the country (Konneh et al., 2020).

Overall, the literature suggests that the operation of landfills in Liberia faces several challenges, including a lack of proper infrastructure and management, as well as a lack of awareness and implementation of proper waste management practices. To improve the management of landfills in Liberia, it will be important to develop and implement effective policies and regulations, and to increase awareness and education about proper waste management practices.

Legal Framework

Waste management in Liberia is governed by a combination of national and international laws and regulations. The primary legislation governing waste management in Liberia is the Environmental Protection and Management Law of 2000 (EPL), which establishes the legal framework for the protection of the environment and natural resources in Liberia.

Under the EPL, the Environmental Protection Agency (EPA) is responsible for the implementation and enforcement of environmental laws, regulations, and policies in Liberia. The EPA is also responsible for issuing permits and licenses for waste management activities and enforcing compliance with waste management regulations. In addition to the EPL, Liberia is also subject to various international environmental agreements, such as the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, which regulates the transboundary movement of hazardous waste and aims to minimize the generation of such waste. Liberia is also party to the Bamako Convention on the Ban of the Import into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes within Africa, which aims to protect human health and the environment from the adverse effects of hazardous waste. However, despite the legal framework in place, the waste management system in Liberia remains inadequate, with limited infrastructure and capacity to manage the increasing waste generated. There are inadequate numbers of waste collection trucks and equipment, and limited numbers of landfill sites, resulting in inadequate waste collection and disposal services.

To address this issue, the government of Liberia has been implementing various initiatives to improve the waste management system, such as the development of a National Solid Waste Management Plan, which aims to improve the collection, transportation, and disposal of solid waste in the country. The

government is also working with international organizations and non-governmental organizations (NGO) to improve waste management infrastructure and capacity.

While there is a legal framework in place for waste management in Liberia, the country's waste management system remains inadequate, with limited infrastructure and capacity. The government of Liberia is working to improve the system, but more effort is needed to fully implement the legal framework and address the waste management challenges in the country.

Solid Waste Generation in Liberia

After organic waste, plastic waste is the second most typical type of waste created in Monrovia. The rise in plastic waste is a result of the expanded use of plastic products in Monrovia (plastic water sachets, PET bottles, and bags). The majority of the other waste generated was made up of plastics (14.2 percent), glass/ceramics (10.5 percent), metals (3.0 percent), rubber (10.0 percent), and batteries (9.9 percent). These results are in line with other research that revealed that organic materials make up a sizable portion of the waste produced in developing countries (UNEP, 2006). The generated waste is mixed randomly and not sorted. On street corners and in open spaces, trash is being burned, buried, or dumped. Refuse bags combined the waste that was collected by both the city of Monrovia and independent businesses (Table 1) (David Jr, et al., 2017). Recycling is either uncommon or not practiced at all in urban areas. Waste is collected twice a week from homes or particular locations in communities. The collection process, however, is ineffective. In the city, waste is thus found on street corners or by the side of the road.

Table 1.

Composition of Solid Waste Generation in Monrovia

NO	Composition	Percentage
1	Paper	12.2
2	Plastic	14.2
3	Glass/ Ceramics	10.5
4	Metal	3.0
5	Organic refuse/ vegetables	40.2
6	Rubber	10.0
7	Batteries	9.9
	Total	100

Disposal in Liberia (Monrovia)

Waste management in the city is the responsibility of the Monrovia City Corporation. The city corporation is in charge of waste collection and disposal, along with the city corporation of Paynesville and five private businesses. It is important to note that the City Corporation and private businesses face difficulties including inadequate logistics, a lack of funding, a shortage of skilled workers, and insufficient cooperation between stakeholders. Whein Town Landfill is the only place where waste is disposed of. However, the landfill is full, so the government has chosen a new landfill location in Cheesmanburgh. The sustainability of any waste management system depends on adequate disposal. Municipal solid waste should be properly disposed of to reduce risks to human health and the environment. 50% of the respondents in the sampled group claimed that their trash was picked up by private companies for disposal at landfills, while 20.2% claimed that they buried trash in their backyards. 17.2% engaged in backyard open burning, 8.8% gave their trash to scavengers, 2% dumped it in rivers, and 1.8% dumped it in swamps.

Municipal Solid Waste Management

Waste is created when a product or material is discarded or not wanted by its owner. The production demands on natural resources are reduced, which is a huge advantage of turning waste materials into finished goods with a market demand. Waste is formally defined by the World Bank as the stage at which the owner or producer discards a material without anticipating any payment (Naidoo, 2009). An heir to the item, a consumer, or the manufacturer of the item can be the owner.

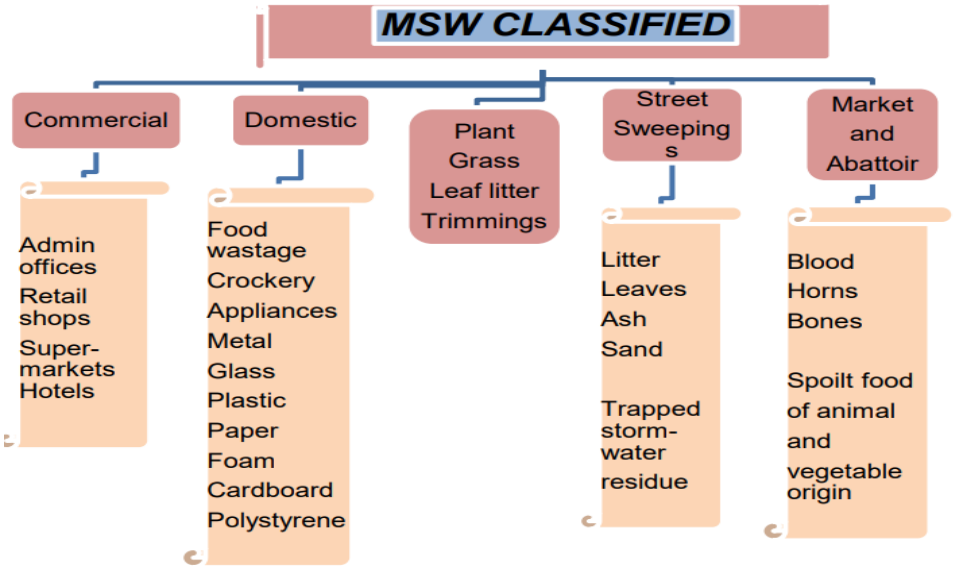
The amount of waste is a reflection of a technological and consumer-driven society. The socioeconomic, sociopolitical, and environmental framework of such a society must be taken into consideration when regulating waste management procedures due to the demographic makeup of the community. To facilitate health, hygiene, and sanitation, SWM is generally defined as litter or refuse that has been removed from residential or commercial areas. Williams (2005) added the definition "waste collected by or on behalf of municipalities" to the definition of SWM. In addition, as garden, park, and street cleaning garbage (trees/branches/leaves) is thought to be the responsibility of local authorities, the solid waste stream may increase in volume. This may vary from household waste and commercial waste, factories, office buildings, and small businesses to government administration

buildings. Solid waste comes in a variety of forms, with SWM and industrial or hazardous waste being the most common distinctions. This heavily depends on the quantity, make up, and toxicity of the waste, which typically calls for specific handling. As a result of being toxic, corrosive, flammable, explosive, reactive, or pathological, household wastes may also be dangerous. Waste oil, paint, and solvents are just a few examples of household hazardous waste. The hazardous components from this family of electrical and electronic wastes include cadmium, lead, mercury, and some ethers. The caveat that needs to be made is that electrical and electronic equipment shouldn't make up a small portion of household waste that is thrown away at a clean landfill (Anderson, 2007; Venter, 2007).

Strong waste in South Africa has an easy-to-understand characterization framework, which is shown in the figure below (Tworeck, 1979). This category of hazardous waste is still in use today despite having been introduced in 1979, and it should be understood in the context that every area of waste creation can and frequently covers with at least one other area. A suitable example would be the waste of polystyrene, glass, porcelain, and food, which frequently occurs in hotels and supermarkets and is not restricted to the local area. Additionally, hotels generate a significant amount of leaf litter as a result of their overall control over sizable green areas that speak to their clientele.

Figure 1.

Classification of Municipal Solid Waste



Global Overview of Landfill

Landfills are a piece of land that is used to dispose of solid waste and other waste by burying it underneath the bed cell and covering it with topsoil. A landfill is usually far away from residential areas, industrial areas, or academic areas due to the possibility of environmental disadvantages it can bring to the ma. Landfills are the most common final disposal sites in both industrialized and developing countries (Ahmed, 2012). Landfilling has been the most popular waste disposal technique worldwide due to their preferable benefits, such as being the most cost-effective option in terms of capital and exploitation costs. Despite being at the bottom of the sustainable waste management hierarchy, final waste disposal techniques such as landfill and incineration are vital. Landfilling is now widely accepted as a safe waste disposal strategy that outdoes incineration because the latter not only reduces waste volume but also produces residuals and gaseous pollutants, which require ultimate disposal (Schiopu and Gavrilescu, 2010).

Landfills are subjected to stringent environmental control during their conception, operation, and post-closure phases, which result in the production of leachate, which has the potential to affect surface and groundwater if appropriate leachate management is not in place. To minimize leachate contamination and migration to the nearby sensitive receptors, the majority of the modern landfills now have engineered liners and a leachate collection and treatment system. Open landfill sites are the most popular method of solid waste disposal in Southeast Asia. Further, landfilling provides cost-efficient disposal of MSW and it's also suitable for the type of wastes that contain more organic matter (Ngoc and Schnitzer, 2009). However, landfills in many places in ASEAN are classically unsanitary open disposal sites without a leachate management system.

Entities Involves with Landfill Management in Liberia

The Act Creating the Environmental Protection Agency of Liberia (EPAL), the Act Adopting the Framework of the Environmental Protection and Management Law, and the Act Establishing the Republic of Liberia's Environmental Policy (all approved on 26 November 2002 and published on 30 April 2003) are the three main legal documents that grant authority in the field of the environment and waste management sector, according to UNEP (2007). The EPAL is defined in sections 37, 38, and 39 of the Act Adopting the Environmental Protection and Management Law

as the coordinator and monitoring body for setting policies and guidelines for waste management in Liberia. In addition, Section 6-C of the Environmental Protection and Management Law grants the entity permission to gather, examine, and compile pertinent data on pollution, deterioration, and environmental quality (UNEP, 2007). Additionally, Section 64 mandates the acquisition of licenses for the production, handling, storage, transportation, and disposal of hazardous waste, while Section 71 mandates the acquisition of a "Pollution Emission License" for any project or activity that is likely to pollute the environment (Environmental Protection Management Law of Liberia, 2002; Act Creating the EPAL, 2002; Earthtime INC, 2008). In the meantime, the EPAL has been working on creating new environmental standards. Several quality standards, such as environmental quality standards for air quality, water quality, and soil quality, have been prepared.

In Liberia, the Monrovia City Corporation is in charge of developing, running, and maintaining landfills. The Public Health Law of 1975 charged this organization with maintaining sanitary and hygienic conditions in Monrovia (Earthtime INC, 2008). The organization is also in charge of planning, developing, operating, and maintaining domestic, public, and non-sewer sanitation facilities in conjunction with the Liberia Water and Sewer Corporation (LWSC) and the Ministry of Health (UNEP, 2007). The Ministry of Health served as the home of the National Environmental and Occupational Health (NEOH) Department, which was established in 2007. Identification of environmental and occupational health needs, including those related to environmental sanitation, water quality and safety, vector control and chemical safety, waste management, health promotion, and pollution control, is the responsibility of the NEOH (Earthtime INC, 2008). According to UNEP (2007), the Ministry of Public Works is in principle responsible for the installation of the entire infrastructure required for the delivery of waste management services, including waste collection and transfer stations and the construction of engineered landfills. The group also manages WASH initiatives in Liberia.

Health Hazards Associated with Landfill Pollution

Landfill pollution is a serious environmental issue that poses significant health hazards to both human and animal populations living near these sites. Studies have shown that exposure to pollutants emitted from landfills, such as volatile organic compounds, heavy metals, and greenhouse gases, can lead to a variety of

health problems, including respiratory and cardiovascular diseases, cancer, and neurological disorders.

One study, conducted by the World Health Organization in 2015, found that people living within 5 kilometers of a landfill site have a higher risk of developing respiratory problems, such as asthma and bronchitis, compared to those living farther away (WHO, 2015). Additionally, a study published in the Journal of Environmental Science and Health in 2016 found that exposure to VOCs emitted from landfills can lead to an increased risk of cancer in nearby residents (Kim et al., 2016).

Another study published in the journal Environmental Pollution in 2019, found that exposure to heavy metals, such as lead and cadmium, from landfill leachate can lead to neurological disorders in both human and animal populations (Li et al., 2019). In addition to the health hazards associated with exposure to pollutants emitted from landfills, these sites can also lead to water and soil contamination, which can further exacerbate health problems. A study published in the journal Chemosphere in 2018 found that leachate from a landfill site in Turkey had contaminated nearby groundwater, posing a significant risk to human health (Ertugrul et al., 2018).

Overall, the research suggests that landfill pollution poses a significant threat to human and animal health, and further efforts are needed to address this issue. Mitigation measures, such as implementing stricter regulations on landfill operations and increasing the use of recycling and composting, can help to reduce the health hazards associated with these sites.

Landfills Emission

Landfills are well-known sources of pollution in the environment. Landfill gas (LFG) is the most significant source of air pollution associated with municipal solid waste landfills (US EPA, 2008). LFG is the gaseous byproduct of anaerobic microbial decomposition of waste organic matter, and it is composed of more than 99% CH_4 (typically in the range of 40-70%) and CO_2 (30-60%) (El Fadel et al., 1997), making it a greenhouse gas. Indeed, LFG is estimated to account for 3-19% of annual anthropogenic CH_4 emissions, though these estimates are subject to significant uncertainty (Park and Shin, 2001). Although CH_4 and CO_2 are odorless, the presence of trace compounds (typically less than 1%), such as H_2S, organic sulfur compounds (Kim et al., 2004), and VOCs (Davoli et al., 2003), gives the LFG a

distinct, highly concentrated, and unpleasant odor. In fact, in many cases, offensive odors are the primary source of people's concerns and complaints about landfills and are thus frequently a barrier to their use or the design and construction of new plants. For these reasons, it is critical to be able to quantify LFG emissions into the atmosphere to measure their environmental effect on the territory couple with protect citizens from odors and potentially harmful pollutants, by employing approp Landfills are a significant source of emissions, including greenhouse gases, leachate, and odors, that can have negative impacts on the environment and human health. These emissions are not only caused by the decomposition of organic matter but also by the presence of certain types of waste and the formation of volatile organic compounds. The mitigation of these emissions is essential for the protection of human health and the environment. However, implementing mitigation techniques can be challenging and costly. In this literature review, it is examined that the current research on the emissions from landfills, including the sources and impacts of these emissions, as well as the mitigation techniques that have been proposed and used.

One of the main sources of emissions from landfills is methane, which is produced by the decomposition of organic matter in the landfill. Methane is a potent greenhouse gas, with a global warming potential 28 times greater than carbon dioxide (EPA, 2018). Landfills are the third-largest source of methane emissions in the United States, accounting for approximately 17% of total methane emissions (EPA, 2018). The capture and utilization of methane from landfills can significantly reduce greenhouse gas emissions and provide a source of energy (Zhu et al., 2020). In a study of 18 landfills in China, Zhu et al. (2020) found that the implementation of gas collection systems reduced methane emissions by an average of 74%. This shows the effectiveness of gas collection systems in reducing methane emissions.

Another significant source of emissions from landfills is leachate, which is a liquid that forms when water percolates through the landfill and picks up dissolved or suspended materials, including pollutants such as heavy metals and other toxins (EPA, 2018). Leachate can contaminate groundwater and surface water and presents a hazard to human health if not properly treated (EPA, 2018). In a study of leachate from a landfill in Egypt, Abd El-Latif et al. (2019) found that the leachate contained high levels of pollutants, including heavy metals, and could have a significant negative impact on the environment and human health if not properly treated. This

highlights the importance of proper treatment and management of leachate to prevent contamination of water resources.

Odor is another common emission from landfills, which can be caused by various factors, including the decomposition of organic matter, the presence of certain types of waste, and the formation of VOCs (EPA, 2018). Odors can be a nuisance to nearby communities and can also present a health concern if they contain harmful chemicals (EPA, 2018). In a study of odors from a landfill in Turkey, Yilmaz et al. (2020) found that the odors were primarily caused by VOCs, including acetone and propanol. The study also found that the use of cover materials, such as clay or geosynthetic materials, can effectively reduce odors. This shows the effectiveness of cover materials in reducing odors from landfills. However, implementing these mitigation techniques can be challenging and costly. For example, gas collection and utilization systems require significant infrastructure and maintenance, and the cost of these systems can be prohibitive for some landfills riate control strategies (EPA, 2018; Palmiotto et al., 2014).

Leachate

Leachate is a contaminated liquid that is generated from water percolating through a solid waste disposal site and moving into subsurface areas. The volume of leachate generated varies with the amount of precipitation and storm water run-on and run-off, the volume of groundwater entering the waste-containing zone, and the moisture content and absorbent capacity of the waste material (Cheremisinoff, 1997). The composition of the waste, the water budget, and other factors all affect leachate quality. Biological processes that are anaerobic become uncontrolled due to the high organic waste content. Leachate pollution will continue to be at high levels after landfill operation has ended for decades or longer (Hans-Jürgen Ehrig, Rainer Stegmann, 2018).

Leachate is the result of two main phenomena occurring in a landfill: infiltration of water in the deposited waste mass and mass transfer of substances from waste to infiltrating water. Leachate extraction, treatment, and recirculation processes provide a substantial contribution to sustainable landfilling. Knowledge of leachate generation mechanisms is fundamental to properly assess and address different aspects of landfill design and management (Alibardi and Cossu, 2018). Leachate is a by-product of municipal solid wastes. It is formed in landfills,

incineration plants, composting plants, and transfer stations. It usually contains various toxic organic pollutants, heavy metals, ammonia nitrogen compounds, and other components. Micronuclei induced by municipal landfill leachate in mouse bone marrow cells in vivo may be used to describe the bio toxicity of leachates. Proper management of landfill is very cardinal for the decline of the amount (Zhao, 2018).

Leachate characteristics depend heavily on several factors, including the age of waste, degree of decomposition, decomposition phase, waste-filling, moisture content, rate of water movement, and temperature. Environmental toxicity and health impacts of wastewaters are strictly governed by their composition. Understanding the natural attenuation of leachate in aquifers is mandatory for evaluating environmental risks associated with leachates entering the groundwater (Jayawardhana and Vithanage, 2016). Leachate characteristics depend heavily on several factors, including the age of waste, degree of decomposition, decomposition phase, waste-filling, moisture content, rate of water movement, and temperature. Environmental toxicity and health impacts of wastewaters are strictly governed by their composition. Understanding the natural attenuation of leachate in aquifers is mandatory for evaluating environmental risks associated with leachates entering the groundwater (Zhao, 2018).

Environmental Impacts of Leachate

Leachate is a liquid that forms when water percolates through a landfill and picks up dissolved or suspended materials, including pollutants such as heavy metals and other toxins. Leachate can have significant environmental impacts if not properly managed and treated. In this literature review, it has examined that the current research on the environmental impacts of leachate, including the sources and composition of leachate, as well as the methods used to mitigate these impacts.

The main sources of leachate are municipal solid waste landfills. The composition of leachate can vary depending on the type of waste in the landfill and the age of the landfill, but it typically contains high levels of pollutants, including heavy metals, organic compounds, and pathogens (Kushner et al., 2019). The presence of these pollutants in leachate can have significant impacts on the environment and human health.

One of the main environmental impacts of leachate is the contamination of surface and groundwater resources. Leachate can contaminate these resources if not

properly treated and managed, potentially impacting the quality of drinking water and the health of aquatic ecosystems (Kushner et al., 2019). In a study of leachate from a landfill in Egypt, Abd El-Latif et al. (2019) it was found that the leachate contained high levels of pollutants, including heavy metals, and could have a significant negative impact on the environment and human health if not properly treated.

Another impact of leachate is the generation of odors and air pollution. Leachate can produce odors as a result of the decomposition of organic matter and the formation of volatile organic compounds (VOCs) (Kushner et al., 2019). These odors can be a nuisance to nearby communities and can also present a health concern if they contain harmful chemicals. To mitigate these impacts, a variety of techniques can be used, including: Leachate collection and treatment systems, which prevent leachate from contaminating groundwater and surface water. Odor control measures, such as the use of cover materials, biocovers, and chemical additives to reduce odors.

Landfill gas collection and utilization systems, which can reduce the amount of leachate generated by reducing the volume of waste in the landfill and increasing the rate of decomposition (Kushner et al., 2019). However, implementing these mitigation techniques can be challenging and costly. For example, leachate treatment systems require significant infrastructure and maintenance, and the cost of these systems can be prohibitive for some landfills (EPA, 2018). Leachate is a significant environmental concern due to its potential to contaminate surface and groundwater resources, generate odors and air pollution. Proper management and treatment of leachate is crucial to prevent these negative impacts. Despite the challenges, it is important to implement these mitigation techniques to protect the environment and human health.

Historically, the need to protect the environment drove the creation of landfills and society from the negative effects of alternate waste disposal techniques, such as bumping into open pits, burning outdoors, and dumping into the ocean (Senior, 1990). While landfills reduced the negative effects of previous practices, others emerged as a result of gas, primarily the production of leachate. These worries encompass fires in addition to potential health risks as well as explosions, ground water contamination, vegetation damage, foul odors, and landfill settlement climate change, pollution, and air pollution. Although methane-rich landfill gas offers a chance for energy recovery, it has (Leckie, 2000).

Related Studies

Vipin Upadhyay et al. (2012) conducted a thorough investigation to gather data on the sources, amount generated, collection, transportation, storage, treatment, and disposal of solid waste on the MNIT Campus. They came to the conclusion that the current SWM system is insufficient and needs to be improved. Recyclable material should be salvaged through a scientifically-approved landfill.

Niyaz Ahmad Khan et al. (2014) conducted research on municipal solid waste management. The amount of MSW generated in Sringar increased dramatically from 180 tons in 1981 to 530 tons in 2011, according to their research. Collection efficiency is between 65 and 70 percent due to uncontrolled management. Into depressions, river embankments, and unattended open spaces, 30-35 percent of waste is illegally dumped.

According to Maryam Masood et al. (2014), they investigated the state of solid waste management in Pakistan's largest city, Lahore. They conducted a methodical quantitative and qualitative assessment of the physical elements of the current solid waste. They created a material flow diagram by carefully observing every step of the waste collection process, from the sources to the disposal. Their research demonstrated that, in the current system, waste collection and transportation are prioritized, but collection efficiency is also important just 68 percent or so. The city does not have a formal recycling program. According to their estimation, the informal sector currently recycles about 27% of waste, measured in weight. Utilizing organic waste, the compost plant generates 47,230 tons annually. To make the current system sustainable and profitable, they recommended that recycling be governed by raising public awareness and integrating the informal sector. They came to the conclusion that the biggest obstacles to enhancing SWM services in the city are a lack of planning and a lack of both political and public will. Future developments ought to concentrate on the composting and recycling areas.

Biubwa Ally et al. (2014) conducted a study on the state of municipal solid waste management in Zanzibar's local government. They found that the municipality had a collection efficiency of only about 50%. The main causes of this are a limited budget, insufficient technical capability, a lack of policy, an incomplete legal and regulatory framework, lax by-law enforcement, and insufficient data on generation rate.

Singh (2015) argued that groundwater sources are contaminated daily by the majority of untreated waste water that enters them. Solid waste needs to be properly collected and disposed of because it is produced by routine tasks and other activities. There aren't enough suitable treatment facilities, there aren't enough funds, and there aren't enough suitable disposal facilities.

In Monrovia, both population growth and urbanization are happening quickly. The rate of waste generation has increased due to patterns and lifestyle. Organic waste (40 percent) and plastic waste (14 percent) account for the majority of the waste produced in Monrovia. There is an inadequate collection system and a lack of qualified professionals (David Jr, Wenchao, 2019).

David (2020) argued that the system for managing municipal solid waste in Liberia is in a terrible state right now. Urbanization's effects on the environment and public health are getting worse. In Liberia, there is a lack of an integrated framework for waste management and the decision-makers lack the motivation to create and put into place such a framework.

CHAPTER III

Methodology

Research Design

The quantitative research aspect was used to perform this study, which will entail collecting data by surveying and interpreting the data. The area under study is located in the suburb of Monrovia specifically Whein Town Paynesville. Fast forward, this study design exclusively surveys design. This research will include field engagement through interviews, using structured survey forms for the collection of data in the form of a face-to-face interview and as such the researcher will seek permission to record the interview. Moreover, given the distance of the researcher, a team of data collectors will be trained online to administer the forms.

Population and Sample

The process of drawing a small group as representative of the whole is referred to as the sampling method (Devi, 1998). A sample size is an element of interest that reflects the entire population. Following Rody & Archaryulu (2009), in research work or study, the sum elements are called population while the sets of elements are called sample. However, the population of Whein Town is 6645 (S.M. Gibson 2020). The researcher will interview 384 residents of the Whein Town Community, specifically residents who are not far from the landfill site. In such a manner, the researcher utilized the below formula in selecting community dwellers to whom the questionnaires will be administered:

$$\boldsymbol{n = \frac{z^2 x\, p(1-p)}{(E)^2}}$$

Whereas:

Z is the Z score

E is the margin of error

P is population

The formula here accounts for 95% confidence and a 5% error margin, as detailed above. Applying the universal sampling method to the confidence level and interval, the 384 was randomly selected across the entire population. This sample in question reflects a proportional representation of the residents of the Whein Town Community. Hence, this study endeavors to gather community residents' views

regarding the extent to which solid waste is managed at the landfill site, coupled with some health and environmental issues precipitated by the presence of the landfill site. Additionally, of the total sample size 157 females were interviewed constituting 40.9% of 384, while males were 227 representing 59.1% of the sample size.

Table 2.

Distribution of the Participants

	Count	Percentage
Female	157	40.9%
Male	227	59.1%
Total	384	100%

Data Collection Tools

The data collection of this study comprises demographic form and detailed research forms. On top of that, the demographic form entails general information pertaining to the respondent, and said information includes, age of the respondent, education level of the respondent, and marital status coupled with household statistics. Additionally, the detailed form comprises structured questions in the following sections: knowledge about solid waste management and evaluation of the municipality.

Data Collection Procedures

In this study, the preoccupation of the researcher was driven by a survey interview. Owing to such, well structures forms will be administered to residents of the Whein Town Community, mainly those whose parcel adjoins the landfill site. Further probes were made to spark up co-founding variables. Finally, the procedure engendered the capturing of strategic footage, as the basis for corroborative evidence.

Data Analysis Procedures

The researcher employed descriptive statistics methods, which provides a simple summary that described the data (Massaquoi, 2016). Data collected was be cleaned in excel and analyzed using SPSS/ Minitab software. Hence, the researcher code and enter the data into SPSS or Minitab and subsequently run for data analysis, and present results in charts and graphs, percentage, and frequency distribution.

Study Area

Liberia's Location

On the Coast of West Africa lies Liberia one of the oldest Republics on the Continent. Its total land coverage is 111,279 km2, of which 96,160 km2 is dry land. It is located between latitudes 4o 18' and 8o 30' North and longitudes 7o 30' and 11o 30' West. The area of the nation is roughly 43,506 square miles. Sierra Leone (306 km) forms Liberia's western border. Guinea (563 km) forms its northern and eastern borders. Côte d'Ivoire (716 km) forms its southern border. Liberia has a coastline that is about 560 km long with low-relief topography. Continuous sand strips and waters and swamplands dominate the landscape (Earthtime INC, 2010).

Whein Town's Location

Around the edges of Monrovia is a town called Whein. It is located 7 kilometers east of Gardnerville, 13 kilometers northeast of Monrovia, 3 kilometers southern Mount Barclay, thence 7 kilometers northern Paynesville. 10 to 66 meters above sea level is the elevation range of the catchment. The site is about 25 acres in size, and between 0 and 1 km away, there are a few scattered residential communities**.**

CHAPTER IV
Findings

This chapter comprises analysis and interprets sets of data attained from the survey reflecting the various variable under review. The results herein are displayed chronologically within these applicable graphs and tables accompanied by all appropriate discussions and explanations. This chapter further engenders the provision of reasonable answers to doubts and questions about the subject of the study.

Solid Waste Knowledge

The receding table (Table 3) communicates the respondents' views regarding factors influencing the increased generation of waste. It depicts that 60.9% of the respondents said the lack of environmental awareness is the factor precipitating the increased generation of waste in Whein Town Community. While 28.9% also said it is due to a low level of educational level, followed by 10.2 % who certainly attributed it to income. The key intention of the question was to test the knowledge of the local people; the following response call for more efforts in terms of awareness across the local populace of Whein Town concerning a wide range of solid issues.

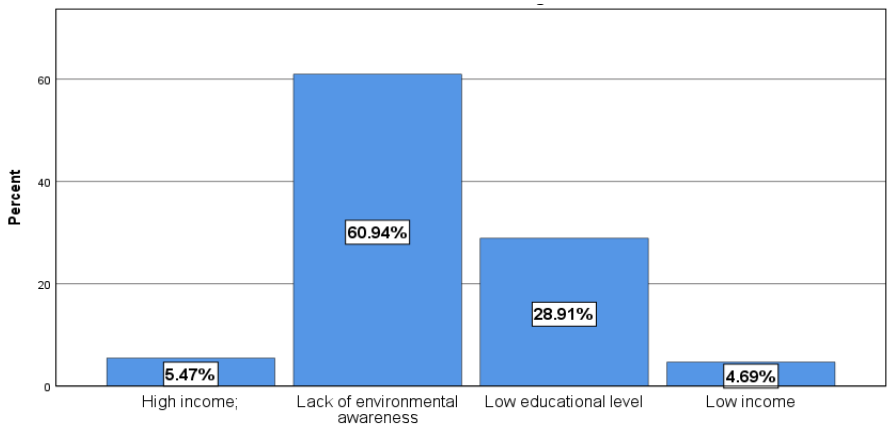
Table 3.

Factors leading more solid generation

Item	Count	Percentage
High income;	21	5.5%
Lack of environmental awareness	234	60.9%
Low educational level	111	28.9%
Low income	18	4.7%
Total	384	100%

Figure 2.

Factors leading more solid generation



Presented in the Figure 3 are statistics detailing the views of respondents about the weight of municipal solid waste per component. The statistics here clearly depict limited knowledge of local people on municipal solid waste, given that 32.8% of the total respondents said they had no idea about the weights of specific components of municipal solid waste. Next in line with the latter, are the following, 27.3% of the respondents also said plastic is heavier than the other components, 22.1% selected glass as the heavier component of municipal, coupled with 17.7% who viewed Organic waste as heavier as compared to other components. The trend of the statistics being detailed here clearly demonstrates the need for municipal solid waste knowledge among local people of the Whein Town Community.

Figure 3.

Weight of MSW Components

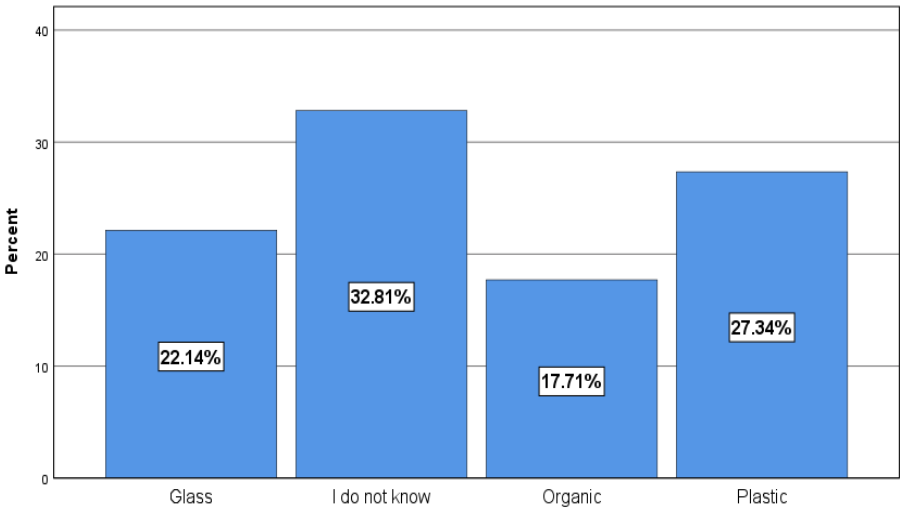


Table 4.

Weight of MSW Components

Item	Count	Percentage
Glass	85	22.1%
I do not know	126	32.8%
Organic	68	17.7%
Plastic	105	27.3%
Total	384	100%

In the wake of fully ascertaining the knowledge of the respondents regarding solid waste, the question concerning what constitutes solid waste. Following a such probe, Table 5 presents the outcome of respondents' views regarding the constituent of solid waste, 62.0 % of the respondent selected all the above (glasses and metal, paper and cloth coupled with organic waste), next in line is another 20.1% of the respondents who also accepted that solid waste constitutes only glasses and metal, along with 10.4% respondents who said solid waste compose of paper only, whereas, 7.6% considered solid waste as the remnants of food only. Despite the 60.9% of the respondents who viewed in whose views solid constitutes all of the above, there is still a lot more to be done in other to augment the knowledge of local people regarding the prime constituents of solid waste.

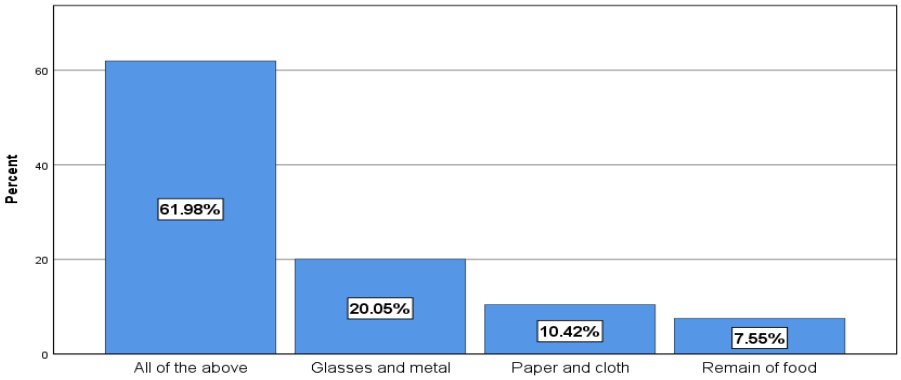
Table 5.

What is solid waste?

Item	Count	Percentage
All of the above	238	62.0%
Glasses and metal	77	20.1%
Paper and cloth	40	10.4%
Remain of food	29	7.6%
Total	384	100%

Figure 4.

What is solid waste?



The Figure 5 under review, classifies the opinions of the respondents regarding recycling, and the data presented here depicted that 52.3% of the respondents upright stated that paper can't be recycled. The factor supporting such an outcome is the lack of industries that reuse paper waste. Another group of the respondents constituting 21.4% proved the lack of knowledge of which solid municipal waste solid components cannot be recycled. Whereas, 15. 1% of respondents said glass is the only component of MSW that cannot be recycled, followed by 11.2% who noted that aluminum is the only component of MSW that can't be recycled. The statistics presented here further prove that the people of Whein Town Community have got limited knowledge of recycling.

Figure 5.

Which waste material cannot be recycled?

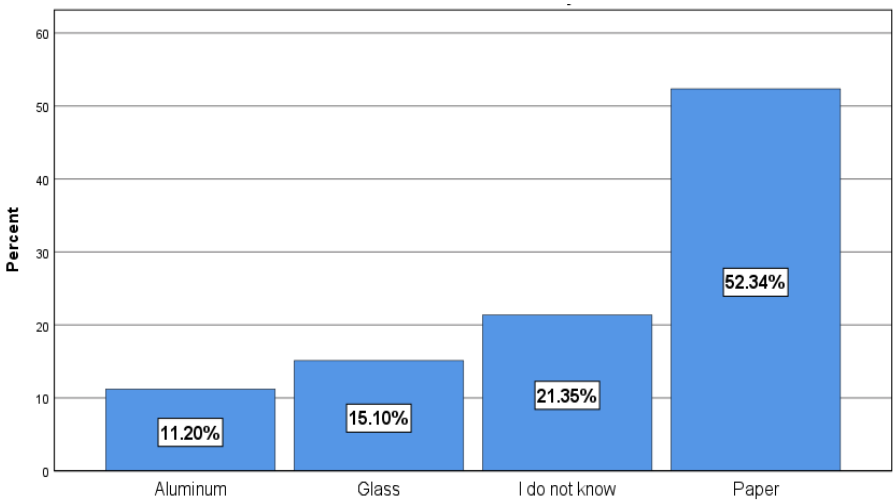


Table 6.

Which waste material cannot be recycled?

Item	Count	Percentage
Aluminum	43	11.2%
Glass	58	15.1%
I do not know	82	21.4%
Paper	201	52.3%
Total	384	100%

The statistics displayed in the Table 7 demonstrate the approach employed by respondents regarding the disposal of MSW. The outcome herein presents the following, a significant portion (62.8%) of the respondents said that burning MSW is the chief approach of municipal solid waste disposal, while 16.9% indicated that they take their waste to the landfill site, another 12% said they take theirs to the Municipality waste collection point. Lastly, 8.3% of respondents accepted placing their waste in the streets as their means of disposal since the municipality has failed to provide them with a suitable stop for disposal. Finally, the data presented here necessitate the need for a robust MSW management approach, ranging from community awareness to the constitution of a consultative MSW management team that promptly collects waste from the community.

Table 7.

MSW disposal approach

Item	Count	Percentage
Burn	241	62.8%
Leave on street	32	8.3%
Municipality to pick a point	46	12.0%
Take to the Landfill	65	16.9%
Total	384	100%

Figure 6.

MSW disposal approach

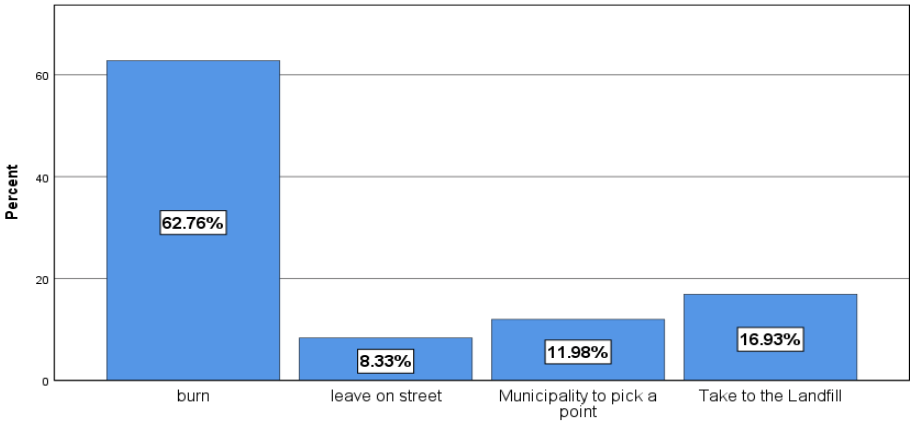


Figure 7 classifies the respondents' opinions on the management of municipal solid waste, and the outcome of the opinions says the following: 37.2% of the respondents believe that solid waste is not managed properly in the Whein Town Community, while 28.4% respondents in their proffered that they have got no knowledge relating the management MSW in the community, while 13.3% of the respondent in opinion indicated that they believe that MSW is managed properly in the Community as well; alongside said opinion, 21.1% of the respondents is of opinion that MSW is managed accordingly in the Whein Town Community. Given these, the statistics here clearly indicate that the management of MSW in Whein Town Community is exponentially poor.

Figure 7.

The level of how solid waste managed

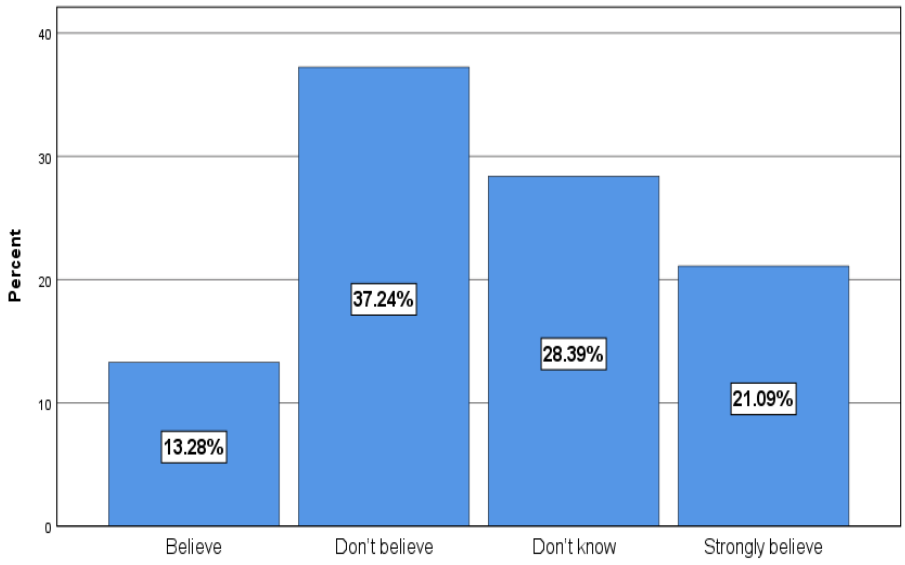


Table 8.

The level of how solid waste managed

Item	Count	Percentage
Believe	51	13.3%
Don't believe	143	37.2%
Don't know	109	28.4%
Strongly believe	81	21.1%
Total	384	100%

Statistics presented in the Table 9 evaluate the knowledge of respondents on MSW sources, and the result shows that 63.8% of the respondents accepted that MSWs are waste generated by institutions, communities, households, etc. follow by another 14.8% of respondents who said MSWs are waste generated by household only, whereas 10.9 % of the respondents are of the opinions that MSWs are wastes generated by institutions only, an opinion which runs parallel with 10.4% respondents who believe that municipal solid wastes are wastes derived from communities only.

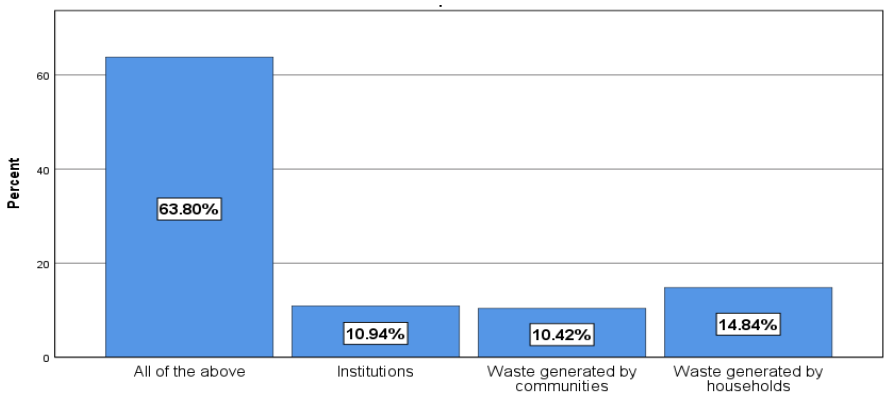
Table 9.

Knowledge on MSW sources

Item	Count	Percentage
All of the above	245	63.8%
Institutions	42	10.9%
Waste generated by communities	40	10.4%
Waste generated by households	57	14.8%
Total	384	100%

Figure 8.

Knowledge on MSW sources



The following statistics presented in Figure 9 depict the knowledge of respondents concerning the impact of solid waste recycling and reuse on the reduction of solid waste generation. And the results above clearly state that a significant portion (37%) of the respondents rightly indicated they got have no idea of the impact solid waste recycling and reuse has on the reduction in solid waste generation. While 26.8% of the respondents agreed that recycling and reuse lead to a reduction in solid waste generation accompanied by 21.1% who also strongly agreed that it does support the reduction in solid waste generation. Whereas, 15.15% of the respondents believe that recycling and reuse have no connection with the reduction of solid waste generation. Again the statists here indicate a serious knowledge problem as a significant portion of respondent lack firsthand information on the impact of solid waste recycling and reuse on solid waste generation.

Figure 9.

Impact of waste recycling and reuse on reduction in waste generation

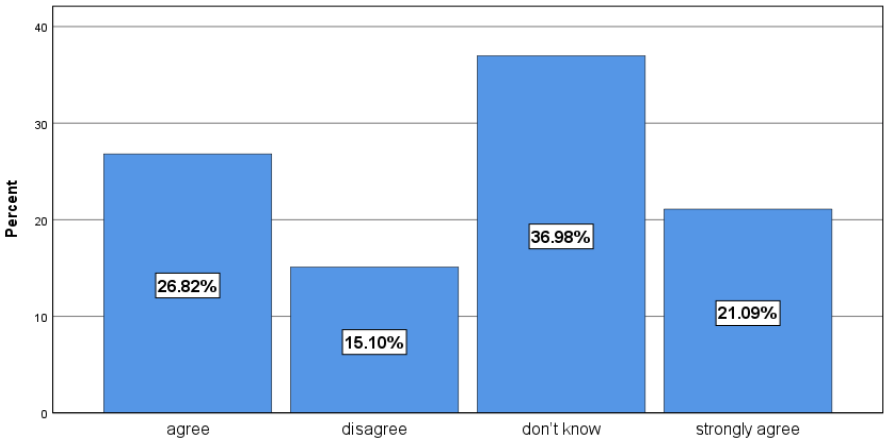


Table 10.

Impact of waste recycling and reuse on reduction in waste generation

Item	Count	Percentage
Agree	103	26.8%
Disagree	58	15.1%
Don't Know	142	37.0%
Strongly Agree	81	21.1%
Total	384	100%

Table 10 displays the judgment of respondents about the effectiveness of the municipality in terms of solid management. Statistics further depict that the municipality is not effective in the management of solid wastes in the Whein Town community as confirmed by a significant number (33.3%) of the participants, while, 37.0 % with frustration on the filthiness of the community said have got no idea on municipality effectiveness. Next in line with the aforementioned statistics, 13.5% of the respondents believe that the municipality is effective in solid waste management, supported by 16.1% who believed that the municipality is very effective in the management of solid waste in the Whein Town Community.

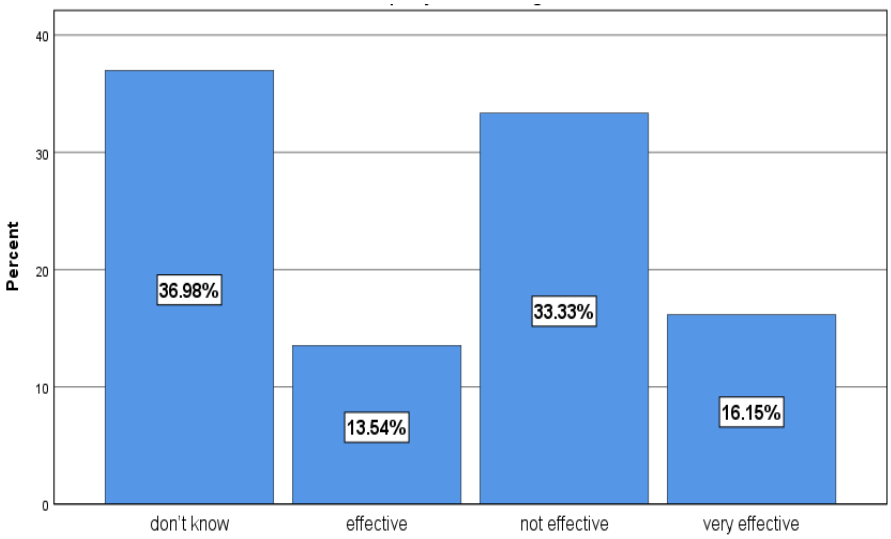
Table 11.

Effectiveness of municipality in the management MSW

Item	Count	Percentage
Don't Know	142	37.0%
Effective	52	13.5%
Not Effective	128	33.3%
Very Effective	62	16.1%
Total	384	100%

Figure 10.

Effectiveness of municipality in the management MSW



Evaluation of the Municipality Regarding Solid Waste Management

Digging further into how the landfill is properly managed, the above data presented in Figure 11, demonstrates that the landfill is poorly managed, given the opinions of the respondents 31.8% disagreed that the landfill is properly managed, coupled with another 30.5% who strongly disagreed that the landfill is properly managed. Alongside the latter, 32.8% of the respondents certainly agreed that the landfill is managed properly, followed by 4.9% who also strongly agreed. Given the results proffered by the above table, the management of the Whein Landfill is astronomically poor.

Figure 11.

Do you agree landfill is managed properly?

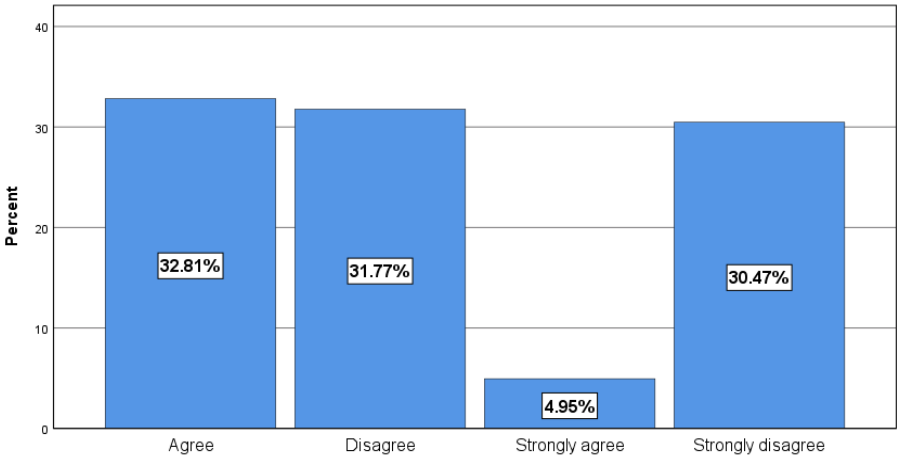


Table 12.

Do you agree landfill is managed properly?

Item	Count	Percentage
Agree	126	32.8%
Disagree	122	31.8%
Strongly agree	19	4.9%
Strongly disagree	117	30.5%
Total	384	100%

Relative to the categories of solid waste being disposed of at the landfill, Table 13, shows that a significant portion of the respondents agreed that all categories of solid waste including hospital waste, household waste, industrial waste, and even chemical waste are disposed at the landfill site. Moreover, 20.1% of the respondents further stated that only industrial wastes are disposed of at the landfill, while 6.3% believed that only household garbage is disposed of at the Whein Town Landfill, coupled with 4.7% respondents who also said only hospital wastes are disposed of the landfill.

Table 13.

What sort of waste is disposed of at the landfill site?

Item	Count	Percentage
All types of waste	265	69.0%
Hospital waste	18	4.7%
Household garbage	24	6.3%
Industrial waste	77	20.1%
Total	384	100%

Figure 12.

What sort of waste is disposed of at the landfill site?

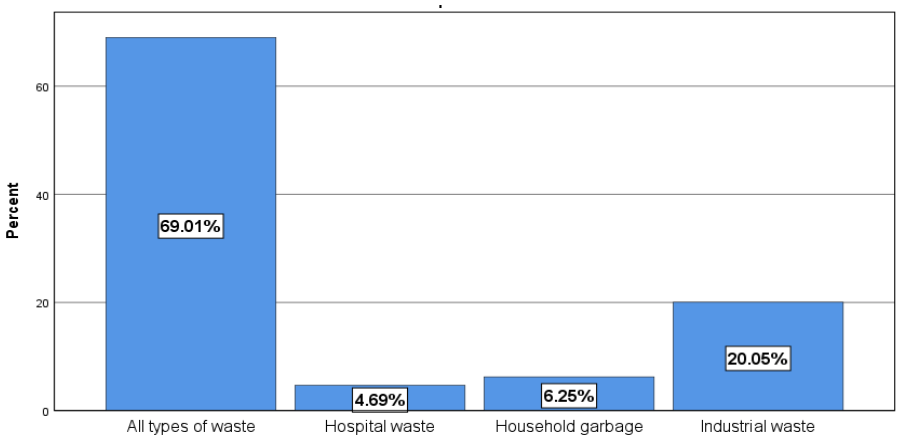


Figure 13 classifies the respondents' opinions on the distance from their houses to the landfill site. And the data depicts that a significant number (36.2%) of the respondents lived just 2-minute walk away from the Whein Town Landfill site, while 29.7% also admitted that they have got no idea of their distance from the Landfill. More besides, 22.1% of the respondents lived 4 minutes away from their household, coupled with 12.0% who reside 3 minutes' walk from the Whein Town Landfill site. The data presented here clearly indicate that the landfill is not far from the residual of the community, thus breeding serious discomfort for dwellers.

Figure 13

Distance between your house and the dumpsite

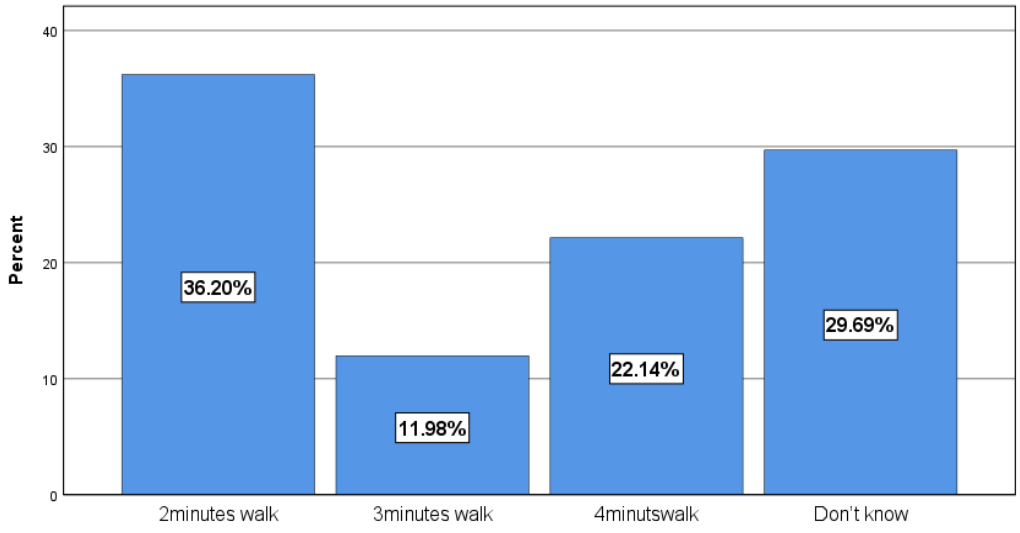


Table 14.

Distance between your house and the dumpsite

Item	Count	Percentage
2minutes walk	139	36.2%
3minutes walk	46	12.0%
4minutswalk	85	22.1%
Don’t know	114	29.7%
Total	384	100%

It appears that the data provided is a survey of people's perceptions of nuisances associated with the solid waste management at the Whein town landfill site. The survey lists various combinations of nuisances and the percentage of respondents who selected each option. From the data provided, it appears that the most commonly reported nuisance is "All of the above" (63.3% of respondents), followed by "Odor" (16.4% of respondents). Other commonly reported nuisances include rats (5.7% of respondents) and house flies and mosquitoes (2.9% of respondents).

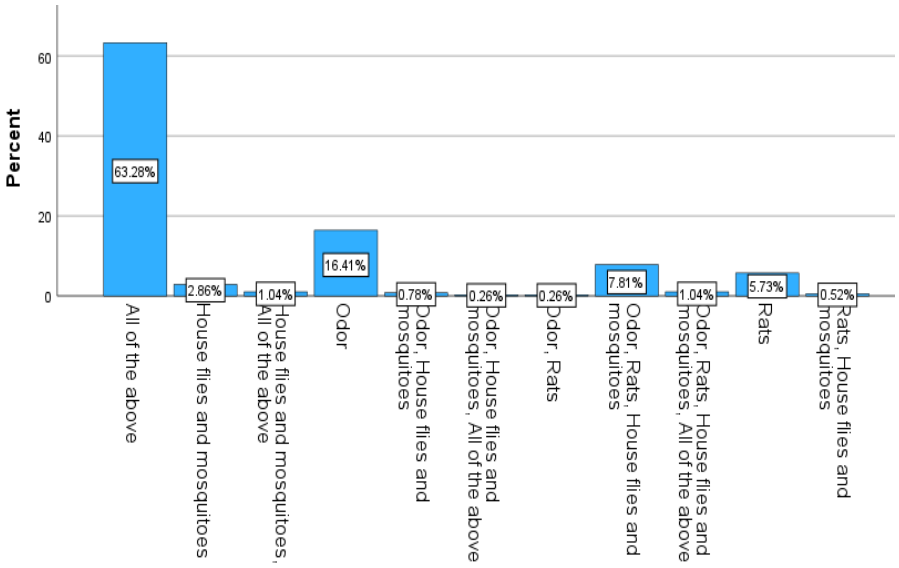
Table 15.

Please identify some of the nuisances

Items	Count	Percentage
All of the above	243	63.3%
House flies and mosquitoes	11	2.9%
House flies and mosquitoes, All of the above	4	1.0%
Odor	63	16.4%
Odor, House flies and mosquitoes	3	0.8%
Odor, House flies and mosquitoes, All of the above	1	0.3%
Odor, Rats	1	0.3%
Odor, Rats, House flies and mosquitoes	30	7.8%
Odor, Rats, House flies and mosquitoes, All of the above	4	1.0%
Rats	22	5.7%
Rats, House flies and mosquitoes	2	0.5%

Figure 14.

Please identify some of the nuisances



It's worth noting that the percentages listed in the question are not clear where it came from. These percentages may not accurately reflect the current situation and should be verified. It also appears that some respondents selected multiple options, indicating that they perceive multiple nuisances to be present. It is important to note that survey data is a way to understand people's perceptions and opinions about a certain topic, but it is important to get more data from the site to understand the real situation.

Figure 15.

What predominant sicknesses/disease conditions do you suffer from?

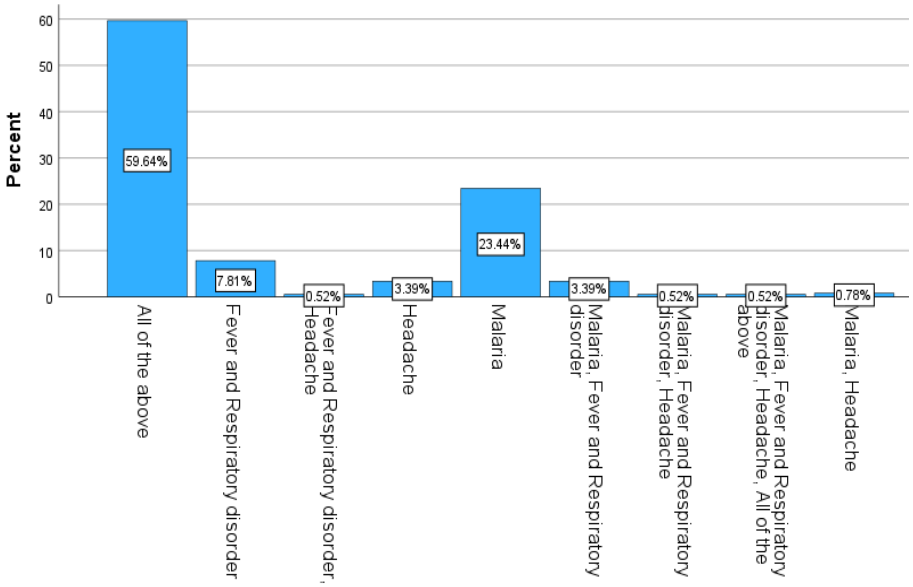


Table 16.

What predominant sicknesses/disease conditions do you suffer from?

	Count	Percentage
All of the above	229	59.6%
Fever and Respiratory disorder	30	7.8%
Fever and Respiratory disorder, Headache	2	0.5%
Headache	13	3.4%
Malaria	90	23.4%
Malaria, Fever and Respiratory disorder	13	3.4%
Malaria, Fever and Respiratory disorder, Headache	2	0.5%
Malaria, Fever and Respiratory disorder, Headache, All of the above	2	0.5%
Malaria, Headache	3	0.8%

This statistic appears to be the results of a survey or research study that asked participants about the predominant sicknesses or disease conditions they suffer from in a specific community. The data shows that the majority of participants (59.6%) reported suffering from "All of the above" sicknesses or disease conditions, followed by Malaria at 23.4%, Fever and Respiratory disorder at 7.8%, and Headache at 3.4%. A small percentage of participants (3.4%) reported suffering from a combination of Malaria, Fever and Respiratory disorder, and a smaller percentage (0.5%) reported suffering from a combination of Malaria, Fever and Respiratory disorder, and Headache.

The interpretation of this statistic is that the majority of participants in the study are suffering from multiple sicknesses or disease conditions, with Malaria being the most common. This suggests that there may be a high prevalence of Malaria in the community, as well as other sicknesses or disease conditions such as fever and respiratory disorder and headaches. Additionally, the small percentage of participants reporting suffering from a combination of multiple conditions implies that the community could be suffering from a high burden of multiple diseases. This could be a result of poor sanitation, lack of access to healthcare and poor living conditions in the community.

Figure 16.

Cause of illness

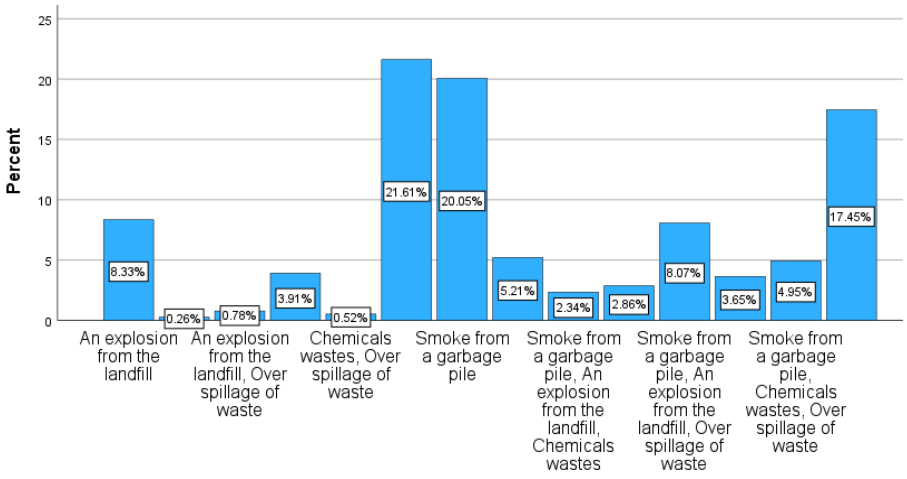


Table 17.

Cause of illness

Items	Count	Percent
An explosion from the landfill	32	8.3%
An explosion from the landfill, Chemicals wastes	1	0.3%
An explosion from the landfill, Over spillage of waste	3	0.8%
Chemicals wastes	15	3.9%
Chemicals wastes, Over spillage of waste	2	0.5%
Over spillage of waste	83	21.6%
Smoke from a garbage pile	77	20.1%
Smoke from a garbage pile, An explosion from the landfill	20	5.2%
Smoke from a garbage pile, An explosion from the landfill, Chemicals wastes	9	2.3%
Smoke from a garbage pile, An explosion from the landfill, Chemicals wastes, Over spillage of waste	11	2.9%
Smoke from a garbage pile, An explosion from the landfill, Over spillage of waste	31	8.1%
Smoke from a garbage pile, Chemicals wastes	14	3.6%
Smoke from a garbage pile, Chemicals wastes, Over spillage of waste	19	4.9%
Smoke from a garbage pile, Over spillage of waste	67	17.4%
Total	384	100%

The above table presents the opinions of respondents regarding the causal agent of the sicknesses affecting community dwellers of the Whein Town Community. The data here shows that 21.6% agreed that over-spillage waste is the prime causal agent of sicknesses leading to the health condition of the community, followed by 20.1% who accepted smoke from garbage fire as the causal agent. Next in line are the following, 17.4% smoke and garbage over spillage of waste from the landfill, 8.3% explosion from the landfill, smoke and explosion from the landfill, 8.1% Smoke from a garbage pile, 5.2% Smoke from a garbage pile, An explosion from the landfill, 3.6% Smoke from a garbage pile, Chemicals wastes, 3.9% Chemicals wastes, 4.9% Smoke from a garbage pile, Chemicals wastes, Over spillage of waste, 2.9% Smoke from a garbage pile, An explosion from the landfill, Chemicals wastes, Over spillage of waste, 2.3% Smoke from a garbage pile and An explosion from the landfill, Chemicals wastes. The results indicate that there are severe health concerns associated with the landfill's existence in the Whein Town Community.

Table 18.

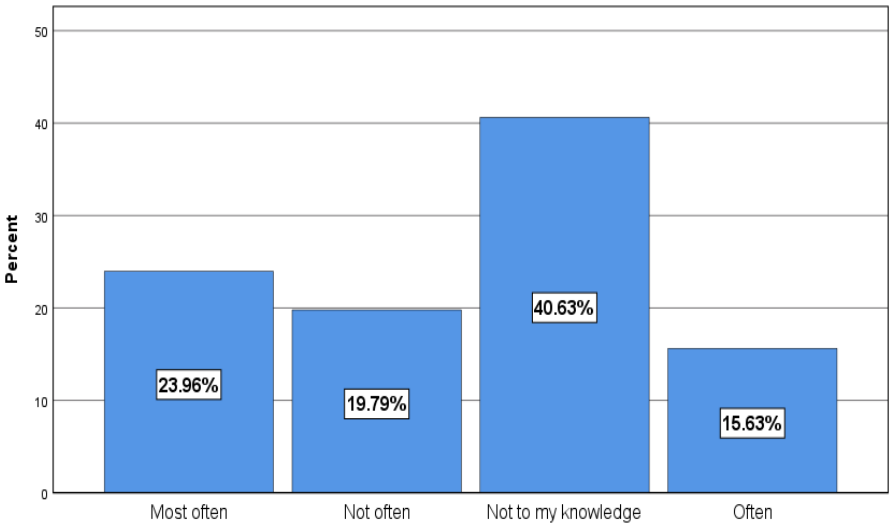
Do you frequently or sometimes hear explosive noise from the landfill site

Item	Count	Percent
Most often	92	24.0%
Not often	76	19.8%
Not to my knowledge	156	40.6%
Often	60	15.6%
Total	384	100%

The above table classifies the respondents' opinion about explosive noise from the landfill site, the result shows the following: a significant (40.6%) portion of the respondents said they have got no knowledge of hearing explosive noise from the landfill, while 24% said they most often hear explosive noise from the, accompany by 15.6% who also alluded to hearing explosive from the landfill. Furthermore, 19.8 also said not often (Figure 17).

Figure 17.

Do you frequently or sometimes hear explosive noise from the landfill site



The Figure 18 presents respondents' views on other concerns they have relating to the landfill, and it shows the following, a significant (57.6%) portion of the respondents alluded to having experienced all of the above (air pollution, noise pollution, and water pollution. Follow by 20.1% who agreed that they observed water pollution exclusively, 17.2% also noted air pollution, while 5.2 experienced noise pollution. The data depicts the alarming discomfort community dwellers experienced due to the poor management of the landfill site.

Figure 18.

What other concerns do you have about the landfill site?

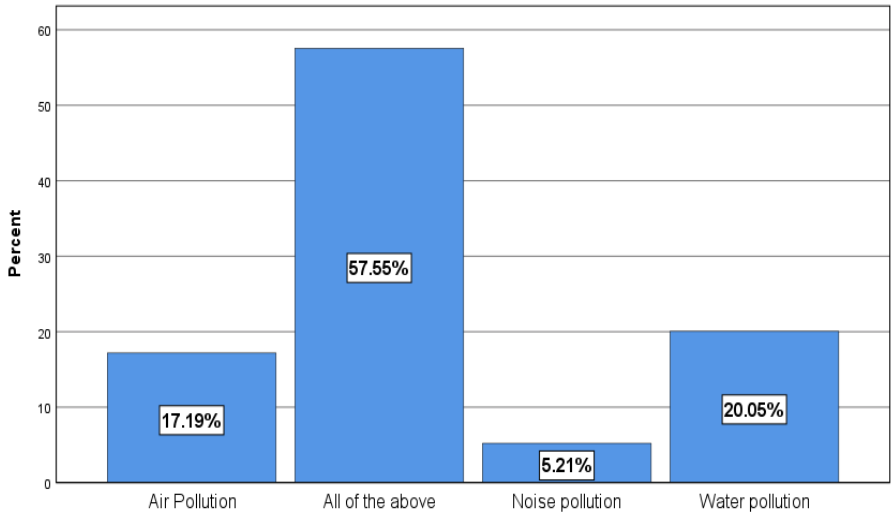


Table 19.

What other concerns do you have about the landfill site?

Item	Count	Percentage
Air Pollution	66	17.2%
All of the above	221	57.6%
Noise pollution	20	5.2%
Water pollution	77	20.1%
Total	384	100%

Table 20 statistic appears to be the results of a survey or research study that asked participants about their source of drinking water. The data shows that the majority of participants (67.7%) reported using hand dug well as their primary source of drinking water, followed by borehole at 30% and pipe run water at 0.8%. A small percentage of participants (6%) reported using a combination of hand dug well and borehole as their primary source of drinking water, and an even smaller percentage (0.5%) reported using a combination of hand dug well, borehole, and pipe run water.

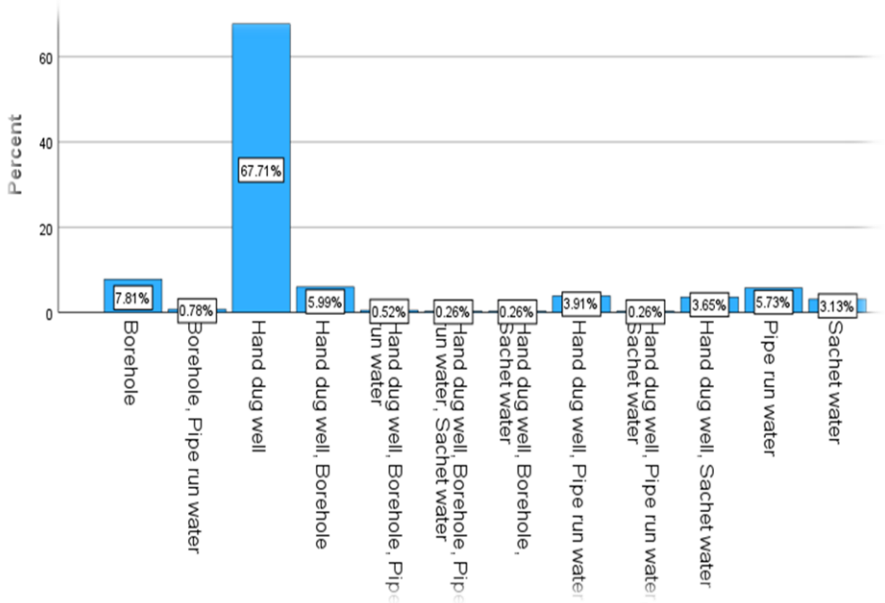
Table 20.

What is the source of your drinking water?

Item	Count	Percentage
Borehole	30	7.8%
Borehole, Pipe run water	3	0.8%
Hand dug well	260	67.7%
Hand dug well, Borehole	23	6.0%
Hand dug well, Borehole, Pipe run water	2	0.5%
Hand dug well, Borehole, Pipe run water, Sachet water	1	0.3%
Hand dug well, Borehole, Sachet water	1	0.3%
Hand dug well, Pipe run water	15	3.9%
Hand dug well, Pipe run water, Sachet water	1	0.3%
Hand dug well, Sachet water	14	3.6%
Pipe run water	22	5.7%
Sachet water	12	3.1%

Figure 19.

What is the source of your drinking water?



The interpretation of Figure 19 statistic is that hand dug well is the most common source of drinking water for the participants in the study, followed by borehole and pipe run water. This suggests that there may be a lack of access to piped water and/or boreholes in the area where the study was conducted. It's also worth mentioning that the small percentage of participants reporting using a combination of sources of water could indicate that they are using multiple sources to ensure a steady supply of water.

Figure 20.

Which of the above do you mostly depend on?

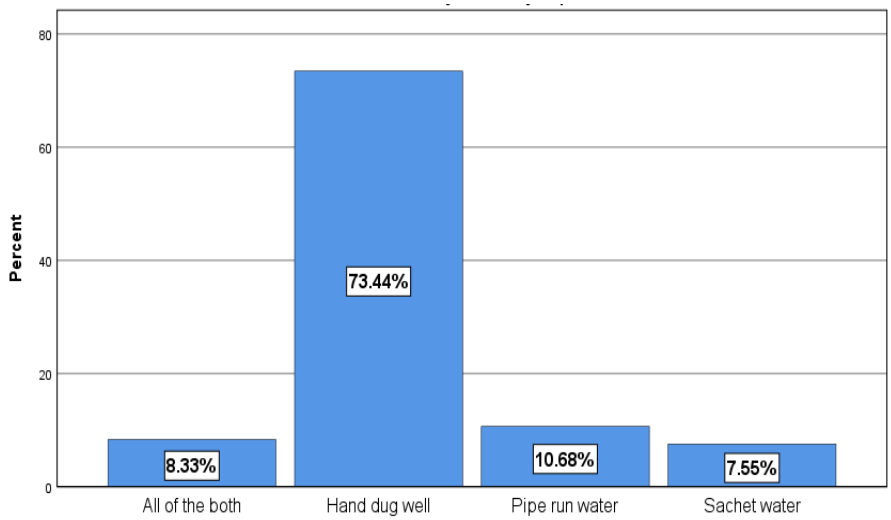


Table 21.

Which of the above do you mostly depend on?

Item	Count	Percentage
All of the both	32	8.3%
Hand dug well	282	73.4%
Pipe run water	41	10.7%
Sachet water	29	7.6%
Total	384	100%

Regarding the source of water, the Table 21 displayed here presents data relating to the source of drinking water for the community. Results here communicate the following, 73.44% of the respondents depend on hand dug well as their source of drinking water, 10.7% also depend on pipe-run water as their source of drinking water, while 8.3% accepted all of the above sources, coupled with 7.6% who rely on sachet water as their source of drinking water.

In a quest to understand the problems associated with the source of water, the above table presents the following, 37.5% of the respondents accepted all of the above (Table 22) color, smell/ odor, and taste, 30.7% said the water has taste, 22.7% also indicated smell/odor, coupled with 9.1 % who alluded that their water got color. The statistics here clearly depicts pollution of water source by the leaching of some heavy metal from the landfill.

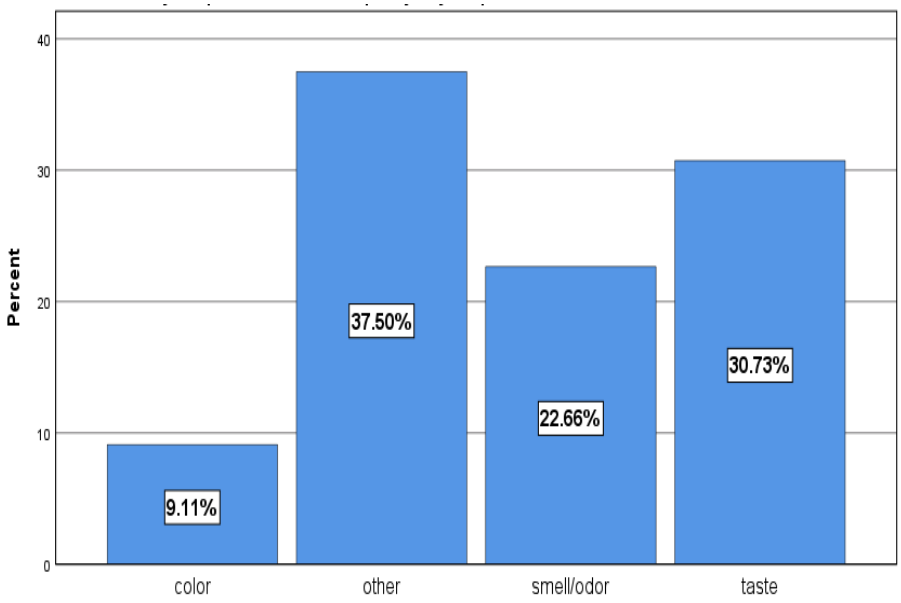
Table 22.

Identify the problems with the quality of your potable water sources Well/Borehole

Item	Count	Percentage
Color	35	9.1%
All of the above	144	37.5%
Smell/odor	87	22.7%
Taste	118	30.7%

Figure 21.

Identify the problems with the quality of your potable water sources Well/Borehole



The Figure 22 classifies the opinions of respondents considering the factors affecting the quality of water. It shows that 30.2% of respondents said the prime cause of the poor water is water pollution, 43.2% not to my knowledge, 13.5% leaching, and 13.0% lack of waste management.

Figure 22.

In your estimation, what is responsible for the water quality problems you observed?

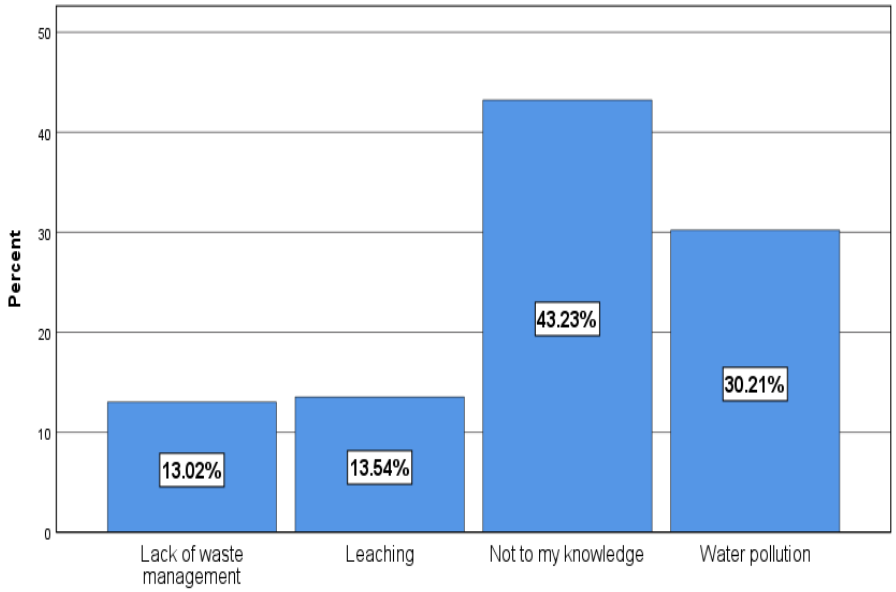


Table 23.

In your estimation, what is responsible for the water quality problems you observed?

Item	Count	Percentage
Lack of waste management	50	13.0%
Leaching	52	13.5%
Not to my knowledge	166	43.2%
Water pollution	116	30.2%
Total	384	100%

The displayed here detailed the opinions of respondents, and what health problems have encountered with the water source drink from, with evidence from the data that 57.0% encountered diarrhea, 21.1% typhoid, 13.5% cholera, and 8.3% encountered ringworm on their skin (Table 24, Figure 23). The statistics imply that community dwellers of Whein Town suffer poor health conditions resulting from drinking water from polluted hand-dug wells.

Table 24.

What health problems have you encountered with the water source you drink from?

Item	Count	Percentage
Cholera	52	13.5%
Diarrhea	219	57.0%
Ringworm	32	8.3%
Typhoid	81	21.1%
Total	384	100%

Figure 23.

What health problems have you encountered with the water source you drink from?

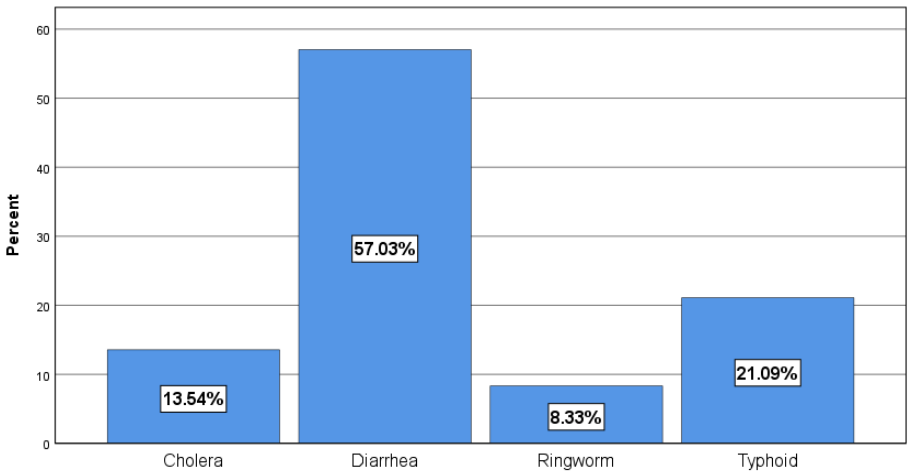


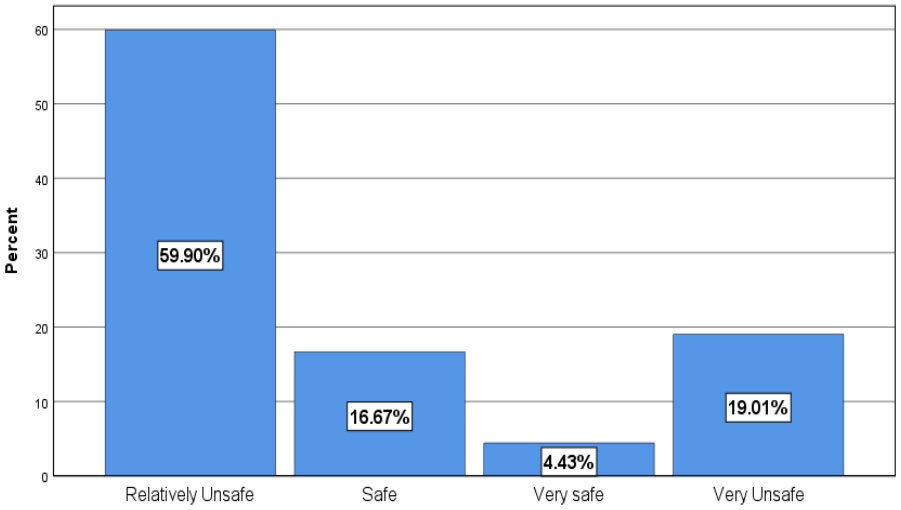
Table 25.

Would you say that this residential area is …?

Item	Count	Percentage
Relatively Unsafe	230	59.9%
Safe	64	16.7%
Very safe	17	4.4%
Very Unsafe	73	19.0%

Figure 24.

Would you say that this residential area is …?



Regarding the safety of residential areas, the above table presents the views of respondents, it shows that 59.9 % say the community is relatively unsafe, 19.0% very unsafe, 16.7% say it is safe, followed by 4.4% who alluded to their area is very safe. The statistics indicate a serious problem relating to the health and environmental safety of the community due to poor landfill management.

Figure 25.

Access to Training

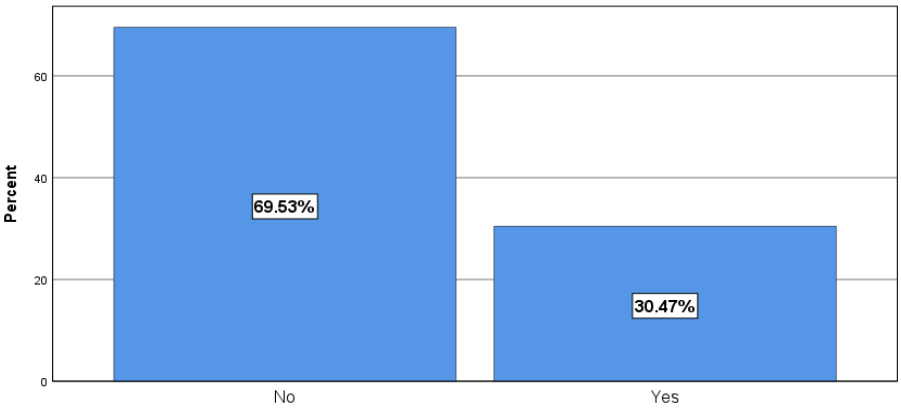


Table 26.

Access to Training

Item	Count	Percentage
No	267	69.5%
Yes	117	30.5%

Concerning the respondents' access to training on municipal solid waste management, the statistics presented in Table 26. Reveals the following 69.5% of the says they lack access to municipal solid waste management training, while 30.5% alluded to accessing municipal solid waste management.

Figure 26.

Are you interested in training?

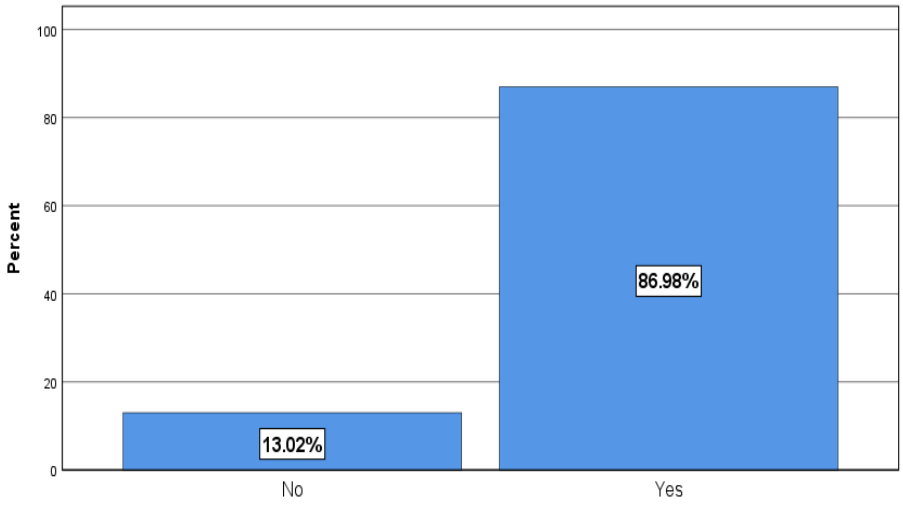


Table 27.

Are you interested in training?

Item	Count	Percentage
No	50	13.0%
Yes	334	87.0%
Total	384	100%

The data presented in this table are respondents' views on the need for training, it shows that the need for training is high among local people in the Whein Town Community given the following data: 87.0% stressed the need for solid waste management training, coupled with 13% who expressed no interest in training.

Figure 27.

How often does environmental sanitation take place in your community?

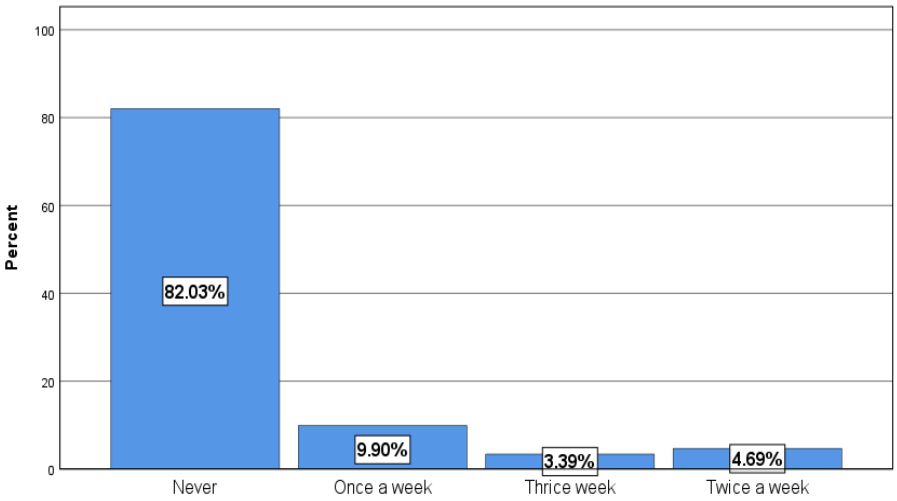


Table 28.

How often does environmental sanitation take place in your community?

Item	Count	Percentage
Never	315	82.0%
Once a week	38	9.9%
Thrice week	13	3.4%
Twice a week	18	4.7%
Total	384	100%

Concerning environmental sanitation, the above table presents views of respondents regarding how often the municipality and the Whein Town Landfill Management carried out environmental sanitation, thus disinfecting community due to the presence of the landfill; the result shows 82.0% of the respondents says there has never been any form of community sanitation. Next in line are the following, 9.9% says once a week, 4.7% twice a week and 3.4% who also said thrice a week.

Table 29 displays respondents' views relating to the rate at which municipal solid waste is managed in the Whein Town Community by the municipality and the data shows the following: 60.9% bad, 16.4% good, 15.9% worst, followed by 6.8% better. This statistic is certainly a crystal manifestation that the performance of the municipality in terms of Municipal Solid Waste Management in the Whein Town Community is very poor, thus resulting in the filthiness of the community.

Table 29.

How can you rate waste management situation in the community?

Item	Count	Percentage
Bad	234	60.9%
Better	26	6.8%
Good	63	16.4%
Worst	61	15.9%
Total	384	100%

Figure 28.

How can you rate waste management situation in the community?

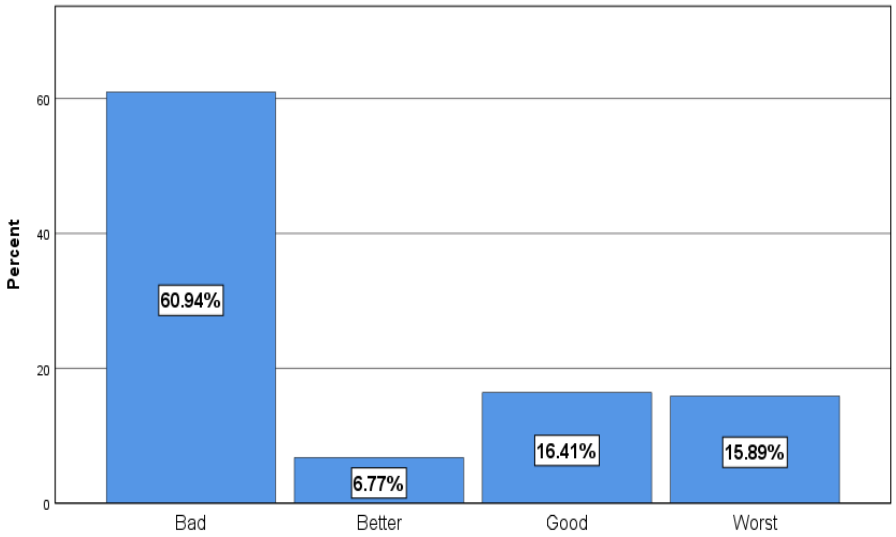


Figure 29.

Adequacy of available waste management services in community

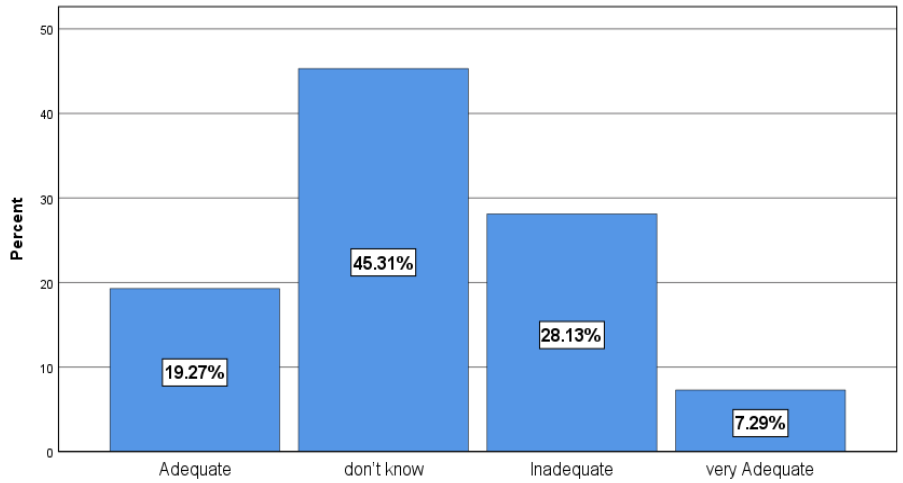


Table 30.

Adequacy of available waste management services in community

Item	Count	Percent
Adequate	74	19.3%
Don't Know	174	45.3%
Inadequate	108	28.1%
Very Adequate	28	7.3%
Total	384	100%

The statistics as displayed in the above table classify respondent's opinions on the adequacy of available municipal solid waste management in the community, and the result shows that a significant (45.3%) portion of the respondents have no idea of the existence of such service in the community, while 28.1% says it is inadequate, 19.3% says adequate, followed by 7.3% who also said it is very adequate.

Table 31.

Access to waste collection points

Item	Count	Percentage
No	124	32.3%
Yes	260	67.7%

Table 31 and Figure 30 deals with respondents' views on access to waste collections points in the Whein Town Community, its shows 67.71% of the agreed that waste collection points exist in some areas but the waste taken is not attended to in time thus causing spillage waste in the community, while 32.3% said there are no waste collection points in the community.

The data presented in Table 32 and Figüre 31, displays respondents rating of waste collectors in the community, it shows that 55.2% of the respondents agreed that the collector performance rating is very bad, 22.7% says it is worst, while 17.7% rate the performance as good follow by 4.4% alluded that it is good.

Figure 30.

Access to waste collection points

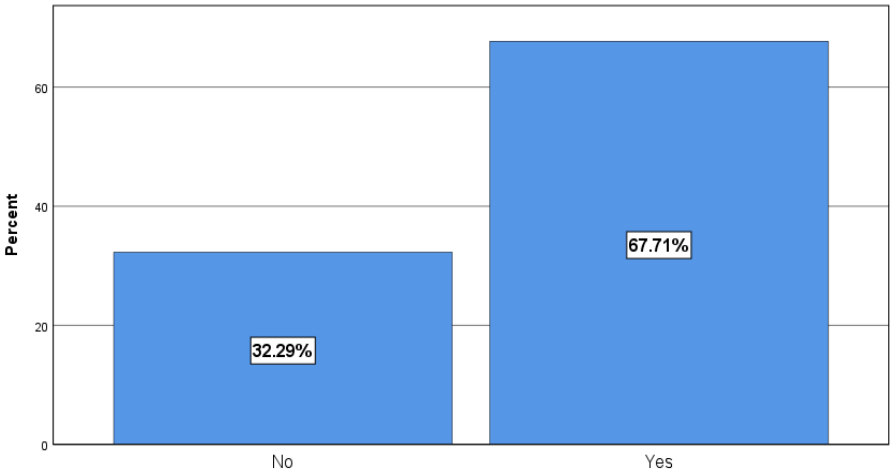


Figure 31.

How would you rate waste collectors?

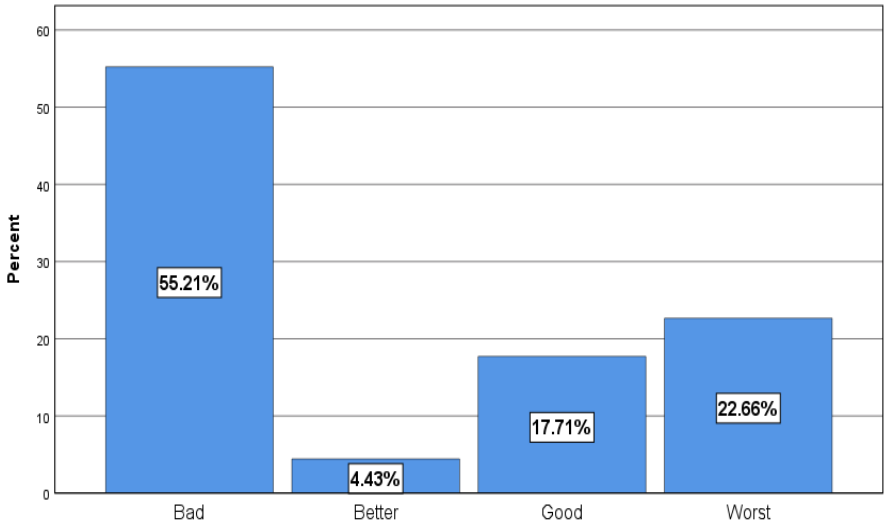


Table 32.

How would you rate waste collectors?

Item	Count	Percentage
Bad	212	55.2%
Better	17	4.4%
Good	68	17.7%
Worst	87	22.7%

CHAPTER V
Discussion

This chapter presents a discussion of findings of the study, as per the research questions:

How do the local people evaluate the municipality regarding solid waste management?

The primary objective of this study Evaluation of Solid Waste Management by Local People at the Wein Town Landfill Site was to access local people's level of evaluation of the municipality in terms of MSW management in the Whein Town Community, coupled with assessing the management standard of waste at the Whein Town Landfill site as well the health condition of community dwellers. In executing this task, the researcher conducted a household survey sampling the views of 384 respondents. Furthermore, the method of the study was survey design thus considering quantitative approach exclusively.

Additionally, descriptive and inferential statistics were used while processing the outcome of the study using SPSS. The finding depicted that municipal solid wastes are poorly managed by the Municipality, as indicated by 33% of the respondents, furthermore, to corroborate these statistics, 31.77% of the respondents also disagreed indicated the Landfill site in Whein Town Community is not managed properly, while another 30.47% strongly disagreed. Municipal solid wastes are not managed properly in keeping with conventional best practices. Field observation during the study revealed that Whein Town is over filthy with waste resulting from over-spillage of waste at various collection points in the community.

Disappointingly, proper municipal solid waste management practices like collection and transportation of waste are far-reaching in the Whein Town Community, as the collection of municipal solid waste rest at some extend on less fortunate youths called zogos. In alignment with the latter, proper household solid disposal is a steep challenge, as 60% of the respondents alluded to burning their waste, while the remaining dumped theirs in the streets, in canals, in various swamps in the community, and in the bushes. The study further revealed recycling is seldom practiced at the landfill site in Whein Town Community. Given these outcomes improving the management of municipal solid waste is the bedrock for enhancing the

overall health conditions of community dwellers. These recounted findings certainly align with David et al. (2019), who argued that solid waste management is pruned by illlegal disposal characterized by burning and dumping of solid waste in swamps and drainages.

How knowledgeable are local people about solid waste management?

The findings from the study indicates that local people's knowledge of solid waste management is below the sub-marginal grade of solid waste management. Knowledge plays a pivotal role in the control of municipal solid waste, therefore, the lack of knowledge about municipal precipitates the proliferation of municipal solid waste, thus posing a matchless health hazard to community dwellers. Interestingly, after sampling the opinions of 384 local people across the entire Whein Town Community, the results revealed that the lack of environmental education or awareness about municipal solid waste, is the male factor leading to the exponential growth in the generation of municipal solid waste, as indicated by significant 60.94% portion of the respondents.

This result demonstrates that the management of municipal solid waste is never possible in the absence of mass public awareness regarding municipal solid waste management. The findings further revealed a knowledge gap among local people of the Whein Town Community, as the majority of the response to the knowledge-based section of the study yielded "I Don't Know". Despite the respondents, the research identified grips on knowledge in terms of the constituents of municipal, but knowledge regarding the conventional handling municipal solid is exponentially, thus resulting in spiraling in the generation of solid waste.

It was also realized that recycling and reuse of waste complete the strange concept of municipal solid waste management among local people within the Whein Town Community. Interestingly, recycling and reuse of municipal solid waste is the beacon of hope for introducing integrated municipal solid waste management thus reducing the generation of waste. Sadly, the practice and approach of recycling are at a snail's pace given that wastes are separated from the source generation. But it was gleaned in the Whein Town Community that everywhere is filthy with improper disposal of municipal solid waste.

Practice and knowledge of municipal solid waste disposal are steadily imperfect and dissatisfactory. In Whein Town Community residents lack to access

proper waste disposal of tips which contributes to unlawful disposal in gullies, river ways, and open spaces. One of the vital services that Whein Town Community is an effective solid waste collector service. Despite the community's attractive proximity to a landfill, attention in terms of management of municipal solid waste is far-reaching.

The Research Evaluation of Solid Waste Management by Local People at the Whein Town Landfill Site, the researcher in the implementation of the task at hand, sought to examine the extent to which solid waste has been managed by the Whein Town Landfill site and the municipality. The key intention was to ascertain full understanding of the environmental and health hazard suffered by those residents of the Whein Town Community, living close to the landfill. However, the findings revealed that the homes of the community dwellers are not far from the landfill facility, given significant number (36.2%) of the respondents who agreed that their houses are 2 minutes-walk away from the Whein Town Landfill site. While another, 22.1% of the respondents indicated that their homes are 4 minutes away from the landfill, coupled with 12.0% who reside 3 minutes walk from the Whein Town Landfill site. The result regarding distance of homes from the landfill, clearly indicates that the landfill is not far from the residential area of the community, thus breeding serious environmental and health hazard.

Consequently, landfills are known for their emission of harmful gases that pose a fatal health hazard to people living in closed range if not managed prudently. And the Whein Town Community scenario is in no way excluded. The unprecedented spread of disease vectors being bred at the landfill, has made the community unsafe as confirmed by 59.9% of the respondents.

The overwhelming presence of these disease vectors in homes couple with bad air quality from harmful gases emissions have triggered unparalleled spread of illnesses ranging from, malaria, respiratory disorder, acute headache, Cholera, Typhoid, Skin irritation and diarrhea. Resultantly, the study discovered triangular sources of environmental and health hazard in the Whein Town community relative to the existence of the landfill. And these triangular sources are (1) landfill gases emission causing air pollution, (2) disease vectors being bred at the landfill, and (3) the percolation of heavy metal into groundwater sources from the decomposition of waste. It was further revealed that the triangular sources of environmental and health hazard are affecting the community contiguously, thus endangering the lives of

residence, especially children. Fast forward, the findings of this study corroborate many studies undertaken in the past to understand the same thematic layer of municipal solid waste under review, as in the case of Njoku et al. (2019), who also indicated that people living closer to landfill site are faced with increased health and environmental risks. Finally, among these issues highlighted by the findings of this research, if the health and environmental risks associated with the presence of the Whein Town Landfill and its subsequent poor municipal solid waste management menace are not given prompt attention, the entire population of the Whein Town stands the risk of future fatal health problem.

CHAPTER VI

Conclusion and Recommendations

In conclusion, the Whein Town community is facing significant challenges in terms of proper landfill management and effective solid waste management by the municipality. These issues have resulted in poor health and significant environmental risks for the residents. These findings highlight the urgent need for intervention and improvement in the waste management practices in Whein Town. This can be achieved through collaboration between the community and the municipality, as well as through the implementation of stricter regulations and improved waste management infrastructure. It's important for the Whein Town community and its government to work together towards a solution that prioritizes the health and well-being of its residents, while also protecting the environment. In light of the findings of this research, it is recommended that the following actions be taken to address the issues of poor landfill management and ineffective municipality in solid waste management in Whein Town:

- Implement stricter regulations for waste management, including penalties for non-compliance, to ensure proper disposal of waste and maintain the integrity of the landfill.
- Increase community education and engagement on the importance of proper waste management, including recycling and composting, to reduce the amount of waste sent to the landfill.
- Develop a comprehensive solid waste management plan that includes the use of modern technologies and equipment to improve the efficiency and effectiveness of waste collection and disposal.
- Collaborate with private sector and Non-Governmental Organizations to provide education and training on waste segregation, composting and recycling to improve the overall waste management.
- Conduct regular monitoring and assessment of the landfill to identify and address any issues, such as leaks and spills, in a timely manner, to minimize the risk of environmental contamination.

- Invest in technology to manage solid waste, such as automated waste collection, to improve the efficiency and effectiveness of waste management in the municipality.
- Increase transparency and accountability in the municipality's solid waste management practices, by providing regular updates to the community and soliciting feedback on the effectiveness of the waste management system.

Overall, it is essential for the Whein Town community and its government to work together in addressing the issues of poor landfill management and ineffective municipality in solid waste management. By implementing these recommendations, the community can improve the health and well-being of its residents, while also protecting the environment.

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Appendices

Appendix A

Ethical Approval

NAER EAST UNIVERSITY

SCIENTIFIC RESEARCH ETHICS COMMITTEE

04.11.2022

Dear Leona Kebeh Cegbe Lcegbe

Your application titled **"Solid Waste Management at The Whein Town Landfill Site a Case Study (Whein Town Community In Liberia)"** with the application number NEU/ES/2022/902 has been evaluated by the Scientific Research Ethics Committee and granted approval. You can start your research on the condition that you will abide by the information provided in your application form.

Prof. Dr. Aşkın KİRAZ

The Coordinator of the Scientific Research Ethics Committee

Appendix B

Consent Form

SOLID WASTE MANAGEMENT AT THE WHEIN TOWN LANDFILL SITE
A CASE STUDY (WHEIN TOWN COMMUNITY IN LIBERIA)

Participant's Information Sheet and Informed Consent Form

Dear Participant,

I write soliciting your involvement in a research or study, intended to investigate the level at which solid waste is managed at the Whein Town Community Landfill site being hosted in your community. The data collected during this study will focus directly on understanding the health risks associated with the presence of the landfill site in your community. More besides, information collected from you will be handled confidentially. Having said such, all views will be respected and utilized for the purpose of impacting policy decisions and academic undertakings only. In the assurance of not taking all of your time, the interview process will last 15-20 minutes.

Leona Kebeh Cegbe
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Prof. Dr. Askin Kiraz
Supervisor
Environmental Education and Management
askin.kiraz@neu.edu.tr

Appendix C

Question Forms (Samples)

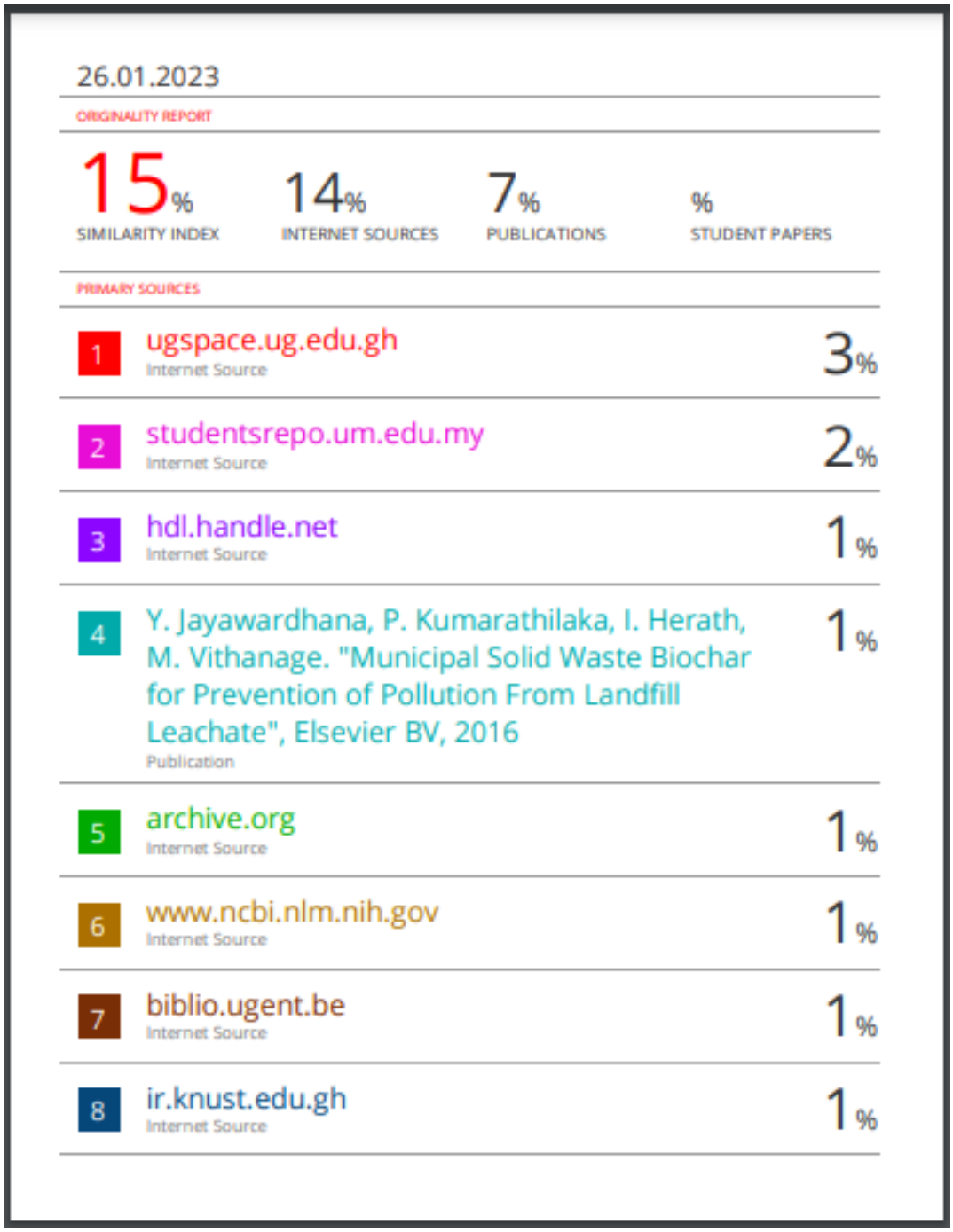
Section I. Demographic Information
Q1. Gender
Q2. Age
Q3. Marital status
Q4. Level of education
Q5. Occupation status

Section II. Solid Waste Knowledge Form
Q1. Which factors lead to more waste generation?
Q4. Which waste material cannot be recycled?
Q6. What approach can be employed to get rid of solid waste?

Section III. Solid Waste Management by Municipality Form
Q1. Do you agree landfill is properly managed?
Q4. How often do you experience bad odor from the land facility in the community?
Q9. Do you frequently or sometimes hear explosive noise from the landfill site?

Appendix D

Turnitin Similarity Report



26.01.2023

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3	hdl.handle.net Internet Source	1%
4	Y. Jayawardhana, P. Kumarathilaka, I. Herath, M. Vithanage. "Municipal Solid Waste Biochar for Prevention of Pollution From Landfill Leachate", Elsevier BV, 2016 Publication	1%
5	archive.org Internet Source	1%
6	www.ncbi.nlm.nih.gov Internet Source	1%
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8	ir.knust.edu.gh Internet Source	1%

Curriculum Vitae

Leona Kebeh Cegbe
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Cell: (231)886661965/ (231)776887910
Email: leonacegbe6@gmail.com

Career goal: Obtaining the position of an educator in an organization that will offer me an opportunity to share my knowledge, skills, and competence.

Basic skills

- Profound knowledge of teaching and learning
- Good organizational skills and ability
- Competence in educational leadership
- Excellent communication skills
- Capacity to research and solve problem
- Ability to motivate others as well as guide them for better results
- Good interpersonal skills
- Technical skills in computer: MS Words and MS Excel

Educational qualification

- Candidate for Master Degree, Environmental Education and Department, 2021-2022
- High School Certificate and Diploma from the St. Michael Catholic High School, New Georgia, Liberia: 2001/2002
- Bachelor of Science (BSc) Degree in Biology: T. J. R. Faulkner College of Science and Technology, University of Liberia, Academic year 2010/11.

Professional Trainings

- Certificate in computer: MS words and Excel: Institute of Basic Technology; 2017
- Certificate in Voluntarisms; National Youth Service Program NYSP; 2016
- Trainer in STEM education, I Help Liberia 2018- present
- Certificate in Brain U Liberia: Ministry of Education and Carter Center; 2018
- Certificate in Science Teacher Training: I Help Liberia & Ministry of Education; 2018

Work Experience

Responsibilities:

- Prepare science lab manual for high school.
- Train science teachers
- Set up science laboratory for high school

Mentor, Institute of Basic Technology 2017 - present

Responsibilities:

- Supervise laboratory manuals preparation for high school students
- Demonstrate Biology Labs for senior high school students
- Train high school teachers in the area of STEM education.

- Council students who have difficulties in their lesson
- Organizing competition for student and providing them the necessary equipment
- Providing a healthy atmosphere for better result in the teaching process

Food Liaison officer: Sean Devereux Children Education & Agriculture Program/ WFP/ JFAP (Gbarpolu County), 2016-2017
Responsibilities:

- Prepare weekly, monthly, quarterly and annual plans in line with implementation plans
- Hold regular meeting with project team/ staff on the goal and objectives of the project
- Prepare progress report on the implementation of project as well as challenges and recommendations to senior management according to the project design.
- Conducted regular field visits, collect data and provides mentorship for field staff in affected communities.
- Participate in the preparation of term of reference for project staff.
- Building relationship with Donors and Partners in project implementation where applicable according to the project design.
- Represent and propagate the project objectives in various stakeholders' meetings.
- Design exit strategies for the end of project so as to encourage ownership and continuation of project gains made thus far.

Volunteer, National Volunteer Program, Ministry of Youth and Sports, Liberia/Ministry of Education, Liberia/Unicef (Cape Palmas High school Maryland County); 2015
Responsibilities:

- Provided study material to students and guiding them for using that material
- Arranged lectures for students on biology subject and offering them additional knowledge of the subject.
- Discussed with the students and clarifying their doubts regarding the study work.
- Arranged the tests for students for being efficient in the subject
- Carry out awareness on HIV & AIDS and Ebola for community's dwellers and student as well.

Research assistance: Agriculture College, University of Liberia, 2011
Responsibilities:

- Conducted a wide variety of survey with Buchanan Renewable Energy, on rubber wood chip.
- Prepared and participated in the preparation and presentation of formal research report.
- Provided technical support, and facilitated the process and findings.
- Worked with other institutional committees and staff to coordinate work and provide assistance, as assigned

Worked as Enumerator: African Technology Policy Studies Network 2010
Responsibilities:

- Conducted a wide variety of survey on climate change in seven counties (7)
- Fill out supervisor daily

- Review data obtained from interview for completeness and accuracy.
- Distributed census questionnaires.
- Conducted personal interviews-fellow up interviews by phone.
- Completed hours work log.

Biology teacher: Lombardia International School System, 2009/2013
Responsibilities:

- Providing study materials to students and guide them in using the materials
- Arranged lectures for students in Biology and offering them additional Knowledge
- Organized competition for students and providing them the necessary Equipment
- Prepared lessons according to the needs of students
- Administered tests and exams for students' evaluation
- Discussed with students and clarifying their doubts regarding the study Work
- Motivate students, evaluating their performances, and providing them a Concrete feedback
- Advising the students regarding study related issues and thus making them proficient in the subject

Worked as a General Science teacher in Henry Taylor Institute, 2007/2008
Responsibilities:

- Planning and implementing lab-based science lessons based on school Standards.
- Constantly encouraging students to grow learn and improve.
- Keeping accurate student report cards as well as attendance and discipline records.
- Teaching a level of science that is appropriate to the maturity and interests of the student
- Teaching Science to groups of students from all abilities.
- Reviewing a student's academic progress against set targets.
- Dealing quickly with inappropriate student behavior.
- Modifying lesson plans to heighten learning
- Engaging students in active learning.
- Ensuring that all lessons are planned with clear aims and objectives.
- Working in partnership with other teaching staff on a daily basis.

Reference:
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