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File name: LIBRARY.docx  
File size: 2.91M  
Page count: 43  
Word count: 8,576  
Character count: 48,927  
Submission date: 31-Oct-2023 03:43PM (UTC+0000)  
Submission ID: 2209162969

### ABSTRACT

This study investigated domestic solid waste management practices and its impacts on community rivers in the Nsawam Adangyiri municipality. Semi-structured questionnaires were designed and administered to 100 respondents conveniently selected from five major towns in the municipal. Data collected was analyzed using the Statistical Package for Social Scientist (SPSS) Software. The study identifies six general waste management practices in the Nsawam Adangyiri Municipal with the majority of respondents (81.0%), indicated door-to-door waste collection as the most practiced, followed by community-led waste collection drive (57.0%), waste burning (55.0%), public waste bin use (54.0%), open dumping (50.0%) and informal waste picking/recycling (48%). However, analysis of domestic solid waste disposal methods used by the respondents showed that 34.1% of the respondents representing majority use the open dumping method, followed by use of public waste bins (29.3%), burning (27.6%), door to door waste collection (3.2%), informal recycling/pickers (2.4%) and 0.8% each for composting, dumping in gutters, use of backyard pits and community dumping site. Again, the study revealed that only a small percentage of participants (10.0%) segregates their solid waste into different categories before disposal. The study also revealed nine reasons for the choice of a particular domestic solid waste disposal methods. The two topmost reasons were, those are the only available disposal methods and it is convenient and free. Also, the study revealed that 72.0% of respondents representing the majority specified that many used the community river side as waste dumping site which has affected the quality of the water body and it life forms. The aforementioned findings offer valuable insights into the practices and challenges of waste management within the municipality, hence it is recommended that adequate supply of waste bins, regular collection of waste, and enforcement of waste management regulations, including fines and penalties should be implemented as well as encourage river clean-up activities through organized events and volunteer programs.

DR. ASANTE EDWARD  
KOFORIDUA TECHNICAL UNIVERSITY,  
KOFORIDUA  
DATE.....

1/11/23

**KOFORIDUA TECHNICAL UNIVERSITY**

**FACULTY OF BUILT AND NATURAL ENVIRONMENT**

**DEPARTMENT OF ENVIRONMENTAL MANAGEMENT AND TECHNOLOGY**



**WASTE MANAGEMENT PRACTICES AND IMPACTS ON COMMUNITY RIVERS IN  
THE NSAWAM ADOAGYIRI MUNICIPALITY**

**BY**

**BONZRA ADU EBENEZER: B403210104**

**A PROJECT WORK SUBMITTED TO THE DEPARTMENT OF ENVIRONMENTAL  
MANAGEMENT AND TECHNOLOGY IN PARTIAL FULFILMENT OF THE  
REQUIREMENT FOR THE AWARD OF BACHELOR OF TECHNOLOGY IN  
ENVIRONMENTAL MANAGEMENT AND TECHNOLOGY.**

**OCTOBER, 2023**

**STUDENT'S DECLARATION**

I hereby declare that, except for the references of the work of other researchers, which I have fully and duly acknowledged, this piece of work embodies results of my own investigation.

SIGN..........

DATE. 26/10/2023.....


BONZRA ADU EBENEZER

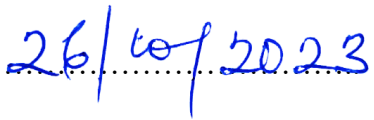
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## SUPERVISOR'S CERTIFICATION

I hereby certify that, I supervised this work in accordance with the guidelines of the project work supervision in Koforidua Technical University.

Name of supervisor: Mr. Paul Tehoda

Signature.....

Date.....

## **ACKNOWLEDGEMENT**

I would like to express my profound gratitude to the Almighty God for my life, strength, guidance, and sustenance throughout my two years' top-up programme in Bachelor of Technology in Environmental Management and Technology, and successfully completing this thesis work. I am extremely grateful to my supervisor, Mr. Paul Tehoda for his devoted attention, guidance, productive scrutiny and suggestions which has helped me to successfully complete this project work.

I also, extend special thanks to the Head of Department Dr. Baa-Poku, for her motherly care and guidance throughout my study. Appreciation to all lecturers in the Department for their total support as well.

Also, I am very grateful to my family, colleagues and all those who in diverse ways contributed to this work.

## **DEDICATION**

This work is dedicated to my lovely mother Madam Comfort Okyere, my lovely Aunty, Madam Beatrice Addo and her husband Mr. Enoch Addo for their care, support and encouragement.

## ABSTRACT

This study investigated domestic solid waste management practices and its impacts on community rivers in the Nsawam Adoagyiri municipality. Semi-structured questionnaires were designed and administered to 100 respondents conveniently selected from five major towns in the municipal. Data collected was analyzed using the Statistical Package for Social Scientist (SPSS) Software. The study identifies six general waste management practices in the Nsawam Adoagyiri Municipal with the majority of respondents (81.0%), indicated door-to-door waste collection as the most practiced, followed by community-led waste collection drive (57.0%), waste burning (55.0%), public waste bin use (54.0%), open dumping (50.0%) and informal waste picking/recycling (48%). However, analysis of domestic solid waste disposal methods used by the respondents showed that 34.1% of the respondents representing majority use the open dumping method, followed by use of public waste bins (29.3%), burning (27.6%), door to door waste collection (3.3%), informal recyclers/pickers (2.4%) and 0.8% each for compositing, dumping in gutters, use of backyard pits and community dumping site. Again, the study revealed that only a small percentage of participants (30.0%) segregates their solid waste into different categories before disposal. The study also revealed nine reasons for the choice of a particular domestic solid waste disposal methods. The two topmost reasons were; those are the only available disposal methods and it is convenient and free. Also, the study revealed that 72.0% of respondents representing the majority specified that many used the community river side as waste dumping site which has affected the quality of the water body and it life forms. The aforementioned findings offer valuable insights into the practices and challenges of waste management within the municipality, hence it is recommend that adequate supply of waste bins, regular collection of waste, and enforcement of waste management regulations, including fines and penalties should be implemented as well as encourage river clean-up activities through organized events and volunteer programs.

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# CHAPTER ONE

## 1.0 INTRODUCTION

### 1.1 Background of the study

Human activities generate wastes, which may be either intentional or unintentional. Humans' poor waste management practises have contributed to ecological and public health problems (Tasantab, 2012). Global solid waste production is on the rise due to demographic and economic expansion as well as increased urbanisation and industrialisation. On a yearly basis, the world's urban areas produce around 1.9 billion tonnes of garbage. The health and environmental difficulties encountered by metropolitan areas, especially in sub-Saharan Africa, need effective solid waste management. Several researchers (Lissah et al., 2021) have found that.

Any product of human activity, whether generated at home, at an organisation, or in an industry, and not destined for disposal via a pipe, is considered solid waste. Domestic, commercial (which includes building and demolition), agricultural, institutional, and other sorts of solid waste are all recognised subsets (Tasantab, 2012). Due to lower population levels, waste management was less of a problem in the past. However, waste management has become a serious issue as urban populations have grown. Rapid urbanisation, a lack of funds for waste planning and management, inadequate technical skills, and slack enforcement of environmental legislation have all contributed to a deteriorating situation. Past attempts to solve this issue have only made things worse in other areas. Therefore, efficient solid waste management has become a practical solution to improve urban cleanliness and public health. Tasantab (2012).

Solid waste management includes all phases of garbage handling, including proper collection, storage, transportation, and disposal. All efforts to lessen the negative effects of solid wastes on human health, the natural environment, and the aesthetic value of a community are included

here. Since proper waste management is crucial to people's health, it's crucial that garbage be handled in a manner that doesn't harm the environment. Malaria, cholera, typhoid, and dysentery are just some of the diseases linked to improper waste disposal. Pollution of the environment, which consists mostly of solid waste, is another problem caused by ineffective waste management that has direct implications for public health. These factors might cause a nation to lose valuable human resources that are essential to its progress.

Private waste management companies are often contracted by Ghana's Metropolitan, Municipal, and District Assemblies (Owusu Ansah et al., 2021) to handle community garbage collection and disposal.

## **1.2 Problem Statement**

Solid waste management is a global societal challenge and most developing countries are struggling to pragmatically address this nuisance. According to World Health Organization (WHO) report, solid waste is identified as the second most essential problem after limited portable water among African countries (Zerbock, 2003). In Ghana, greater part of solid wastes is produced in the cities with high population densities. This coupled with limited and appropriate waste disposal services are resulting to waste build-up and unsanitary conditions within these communities presenting health and environmental problems (Majeed M., *et al.*, 2021).

Domestic solid waste management has emerged as a significant issue in the Nsawam Adoagyiri municipal area in recent years. Mensah (2018) reported that the Nsawam Adoagyiri municipal generates approximately 1000 tons of waste per week, with more than 60% of this waste remaining unprocessed. The primary challenges in managing domestic solid waste in the town include indiscriminate dumping, irregular collection, poor storage, and inadequate resources. The

town is characterized by common instances of littering, clogged gutters, piles of household waste, overflowing dumpsters, and a noticeable lack of dumpsters in many neighbourhoods (personal observation).

### **1.3 Aim N**

The aim of this study was to assess the waste management practices and their impacts on community rivers in the Nsawam Adoagyiri municipality.

### **1.4 Specific Objectives**

The specific objectives were:

1. To determine the solid waste management practices' used in the municipal.
2. To assess domestic solid waste disposal methods' used by household in the municipality.
3. To assess measures to control inappropriate households waste disposal practices in the municipality
4. To determine the impacts of waste management practices on community rivers in the municipal.

### **1.5 Significant of the Study**

Several studies have suggested that a significant portion of the municipal solid waste in developing countries is produced by households (55% - 80%), market areas (10% - 30%), and institutions, among other sources (Nabegu, 2010; Nagabooshnam, 2011; Okot-Okumu, 2012). Furthermore, improper waste disposal practices have detrimental consequences on the natural environment, public health, and the overall well-being of individuals. The availability of comprehensive data on solid waste management conditions in every district, municipal, and metropolitan assembly in Ghana is crucial for the development and execution of efficient solid

waste management policies within the country. Therefore, this study was conducted to provide better understanding on the waste management practices in the Nsawam Adoagyiri municipal by exploring the disposal methods, challenges and impacts on community rivers. Finding of this study has provided a baseline data to be incorporated in the development of mechanisms to improve solid wastes management by the households, municipal and other stakeholders in the municipal and beyond.

### **1.6 Scope and Limitation of the Study**

The area of the study is Nsawam Adoagyiri Municipality in the Eastern Region of Ghana. Contextually, the study focused on domestic solid waste management practices rivers among households and its impacts on community rivers in the Nsawam Adoagyiri Municipality.

### **1.7 Organization of the Study**

This study comprises five chapters. Chapter one provides an overview of the study, including the background, problem statement, objectives, research questions, significance, scope, limitations, and organization. Chapter two provides a comprehensive review of the pertinent literature related to the study. Chapter three discussed the research methods utilized in the study. This chapter provides a comprehensive overview of the study approach, design, area, population, sampling size and technique, data collection tools and process, ethical considerations, and data analysis. Chapter four discusses the findings and provides a discussion, while Chapter five presents a summary of the key findings, conclusions, and recommendations.



## CHAPTER TWO

### 2.0 LITERATURE REVIEW

#### 2.1 Introduction

This chapter examines the literature about waste management. It outlines some problems of Solid Waste and challenges of Urban Waste Management. It also discusses the effects of Municipal Solid Waste on the Environment.

#### 2.2 The Concept of Waste

Buabeng (2020) defines waste as an entity devoid of value or significance to its possessor, having lost its utility. The management of waste presents a substantial and pressing challenge in the modern era for the global population. Despite the extensive efforts made by governments worldwide, it is evident that technology has not been successful in effectively managing waste generation in communities on a global scale. According to Buabeng (2020), a significant issue in African cities is the severe problem of waste disposal, affecting approximately 90% of these urban areas. Cities and towns in Ghana demonstrate manifestations of this problem, such as unregulated accumulations of waste, dispersed polythene bags, and overwhelmed waste disposal sites, which give rise to health risks such as cholera, malaria, and typhoid fever for individuals residing in close proximity. Similar challenges are observed in numerous countries located south of the Sahara, such as South Africa, Zambia, and Zimbabwe. In these regions, the unsightly presence of rubbish bags is often colloquially referred to as the "national flower" due to their ubiquity in the surrounding landscapes. The addressing of waste management in rural areas by stakeholders is of utmost importance, given that the consequences of inadequate waste management and the resulting illnesses extend beyond geographical boundaries. The issue of waste generation is pervasive, occurring in various activities ranging from basic food preparation

to the production of automobiles, thereby presenting a formidable challenge. Therefore, it is imperative that waste management is not exclusively the duty of governmental bodies and waste management operators. Instead, all stakeholders should actively participate in maintaining cleanliness in our environment by embracing a constructive approach towards waste management.

According to Buabeng (2020), there is evidence of objects being suspended on fences, found in gutters, and causing obstructions in drainage systems. It is imperative for stakeholders to prioritize waste management in rural areas alongside urban areas, as the negative consequences of inadequate waste management are not confined by geographical boundaries. Furthermore, illness does not discriminate based on socioeconomic status. The generation of waste material is inherent in various tasks, ranging from culinary activities to automobile production. Consequently, this issue should not solely be delegated to governmental bodies and waste management operators. Instead, all stakeholders must actively contribute to maintaining cleanliness in our surroundings by cultivating a positive approach towards waste management. According to Buabeng (2020).

### **2.2.1 Solid waste**

Tasantab (2012) posits that solid wastes encompass the entirety of waste materials generated from human and animal activities, which are typically deemed as devoid of value or undesirable and subsequently discarded. According to The Sanitation Connection (2002, online), solid waste is defined as "material that lacks value to the individual responsible for its disposal and is not intended for discharge through a pipe." Typically, human excreta is not included in this context. The generation of this substance is attributed to various activities, including domestic, commercial, industrial, healthcare, agricultural, and mineral extraction endeavors. Furthermore,

it tends to accumulate within urban streets and public spaces. The terms "garbage," "trash," "refuse," and "rubbish" are employed to denote various types of solid waste.

Solid waste refers to any solid material that originates from various sources such as domestic, commercial, industrial, agricultural, and demolition activities. It is considered undesirable by its owners. This phenomenon directs our attention towards the origins of solid waste.

### **2.2.2 Sources of solid wastes**

Solid waste is produced from a variety of sources corresponding to the different land uses within a community. Buabeng (2020) categorizes the sources of solid waste in a community as follows:

1. The residential category includes combustible and non-combustible solid waste produced in residential areas. The items encompassed in this category are food waste (garbage), paper, corrugated cardboard, plastics, textiles, rubber, leather, wood and garden waste. The non-combustible (inorganic) fraction includes glass, crockery, tins, cans, aluminium, ferrous metals, and dirt. A considerable proportion of household waste is putrescible, indicating its rapid decomposition, particularly in warm climates. These perishable wastes are produced during the various stages of food handling, preparation, cooking, and consumption. Special residential waste items, including bulky items, consumer electronics, batteries, oil, and tyres, are collected in separate waste streams. Bulky items encompass large, worn-out, or inoperative objects such as furniture, lamps, bookcases, and filing cabinets (Tasantab, 2020).

2. Commercial: Waste generated from commercial sources is similar to residential waste, excluding waste related to cooking and eating.

3. Institutional: This source of waste includes government offices, schools, hospitals, and prisons. Medical waste from hospitals is often handled separately from the general solid waste stream.

4. Demolition and Construction: Waste resulting from repair activities carried out on individual residences, commercial buildings, and other structures. This may include waste from demolished buildings, broken-out streets, sidewalks, and bridges.

5. Waste from municipal services encompasses various types of waste, including street sweepings, roadside litter, municipal litter containers, landscape and tree trimmings, catch basin debris, dead animals, and abandoned vehicles.

6. Other Sources: Additional sources of waste include waste from treatment plants, industrial solid waste, and agricultural waste.

### **2.3 Waste Management in Ghana**

Waste management often presents a hazardous challenge to human health and the environment. Furthermore, in countries dealing with pressing issues like hunger, healthcare, water scarcity, unemployment, and even civil unrest, waste management tends to receive lower priority on the political agenda. This unfortunate reality contributes to the steady growth of waste-related problems (Bowen, 2013). Ghana has a very concerning waste management problem. almost 20% of Ghanaian homes do not have access to a toilet, with that number rising to almost 70% in the three Northern Regions. While 38% of people dump their grey water onto bare land and 21% dump it into gutters, just 5% of the population uses sewage networks linked to treatment facilities (Boakye, 2012).

## **2.4 Solid Waste Management**

Solid waste management (SWM) encompasses a range of activities including waste collection, storage, transportation, processing, treatment, recycling, and final disposal. It is crucial to establish simple, affordable, and sustainable systems that consider financial, environmental, and social aspects. These systems should strive for equity, ensuring that collection services are accessible to both poor and wealthy households. Adequate infrastructure provision and ongoing maintenance are necessary for effective SWM to address the growing challenges influenced by population growth, urbanization, improved living standards, and technological advancements. Various industrialized European countries, such as Britain, France, Spain, Ireland, and Italy, have been labeled as the core contributors to Europe's waste crisis, often depicting them as overwhelmed by a significant volume of municipal waste dumped in landfill sites (Ankra, 2019).

According to Ankra (2019), low income countries are expected to generate 213 million tons of solid waste a day with the population rising to 676 million by 2025. Lower Middle Income ones are also projected to generate 956 million tons of solid waste per day with a population of 2.08 billion.

In addition to food waste (which may be composted), African households often discard sand, gravel, paper, plastic, metals (such as aluminium cans), and glass. Plastic is a significant contributor to environmental degradation, drain clogging, and floods during the rainy season since it is found in municipal solid waste. Normal waste disposal practices have a negative effect on the environment and human health, leading to waste buildup in populated areas and unregulated landfills. When human or animal excreta or medical wastes are present in the waste stream, waste handlers and garbage pickers are particularly at risk and may also become vectors, developing and spreading infections. (Ankra, 2019).

## **2.5 Problems of Solid (Non-Hazardous) Waste and Sewage**

Pollution and unattractive circumstances have hampered economic growth and led to public health issues due to inadequate sanitation and municipal solid waste management. The average daily solid waste generation is calculated to be 0.45kg per person per day. Only around 55% of the solid trash produced in Accra, for example, is collected and disposed of each day (Ghana landfill standards, July, 2002). Since this is the case, garbage piles up for months in metropolitan areas before being removed. (Accra, 2000 AMA (WMD)).

Most of Ghana's solid waste is flushed down storm drains, which ultimately flow into larger bodies of water including rivers, lagoons, and streams. As of the year 2000, around 80% of Accra's sewage treatment facilities were broken, putting a heavy burden on the city's receiving streams and rivers (EPA, 2000). There has been a significant loss of fish and other aquatic life in the Odaw River in Accra due to the high levels of pollution there. It is estimated that the Chemu lagoon in Tema gets around 2 million m<sup>3</sup> of discharges daily from companies in the catchment region. (EPA, 2002).

## **2.6 Challenges of urban solid waste management**

The public's perspective on landfills has a significant impact on how cities handle their solid waste. Public knowledge and engagement are essential to the success of municipal solid waste management initiatives, which include but are not limited to: proper home trash storage, waste segregation, recycling, collection frequency, willingness to pay for waste management services, and resistance to the siting of waste treatment and disposal facilities. Proper solid waste management is just as important for the health and well-being of the people as awareness and engagement in the management of the disposal sites. As a result, it is more difficult to implement community and societal strategies for SWM service management.

## **2.7 Effects of Municipal Solid Waste on the Environment**

Urban individuals, especially those who live in close proximity to landfills, are at danger from water contamination, unsafe food options, air, land, and vegetation pollution due to unchecked solid waste disposal. Environmental deterioration, ecological damage, and significant threats to human health are all caused by improper solid waste disposal and processing. The buildup of solid wastes poses a danger to the environment and the health of city dwellers (UNEP, 2005). Health risks, water and soil contamination, unpleasant odors, and unpleasant sights are only some of the environmental issues caused by solid waste. As a result, the quality of our environment is deteriorating (Abdus-Salam et al., 2011).

The majority of landfills are situated close to inhabited areas and ecologically sensitive areas like wetlands. Most landfills aren't ideally located for the absorption of hazardous materials. As a result, they may react to the release of contaminants into the environment, either via leachates or dumpsite gases (Nyandwaru, 2017). Many water sources have been labelled as potentially harmful to human health and other forms of life (Moh, 2012).

Most of the dumps that haven't been monitored in a long time have been using unregulated waste disposal methods for decades. The environmental effects of dumps are substantial. The health of the land, sea, and air is seriously threatened by solid waste (Nyandwaru, 2017).

## **2.8 Early Solid Waste Management Practices**

Tasantab, (2012) identified the early practices of solid waste management, perhaps before the proliferation of advance knowledge on best ways of managing waste. These practices include:

1. Dumping on land, canyons and mining pits
2. Dumping in water

3. Ploughing into the soil

4. Feeding to hogs

5. Burning

Despite advancements in waste management, these practices continue to be utilized in the present era, despite the expectation of adopting more effective and sustainable methods. The management of solid waste in Ghana's towns and cities is characterized by the widespread practice of dumping waste in open spaces and depressions. Burning is prevalent in both urban and rural areas of the country. Solid waste disposal in gutters and drainage channels contributes to urban flooding, particularly in areas with high prevalence. This section will analyse the transition from traditional waste management practices to modern methods. According to Tasantab (2012).

## **2.9. Modern Solid Waste Management Practices**

Conventional and early practices of solid waste management caused a wide variety of environmental difficulties, thus it's clear that we need to investigate more sustainable, people-friendly alternatives. Source reduction, composting, recycling, incineration, and sanitary land filling are some of the more modern approaches of manage solid waste (Tasantab, 2012).

### **2.9.1 Source reduction**

The goal of waste reduction is to lessen the quantity, mass, and toxicity of garbage before it is disposed of in an incinerator or landfill. Waste reduction and reusing materials are two strategies for minimizing trash right where it originates.

Instead than concentrating on technology to enhance management, Srinivas (2006) argues that waste reduction should attempt to reduce waste creation via education and better manufacturing



methods. By maximizing resource utilization and decreasing the quantity of trash that must be removed, reducing waste production may have a positive impact on both costs and earnings.

The concept of reuse refers to the home separation of recyclables such as bottles, plastic bags, cardboard, and cans. Reusing items helps cut down on waste and saves valuable supplies. There is a connection between this and on-site separation and processing, which is done to salvage any materials that may be sold. Other recyclable materials are also collected and prepared for recycling. According to Tsiboe and Marbell (2004), three European countries have developed the necessary management processes to efficiently resolve the waste disposal problem by encouraging people to sort their household trash into glass, paper, and plastic bins for easy collection and, ultimately, reuse. These countries are Austria, the Netherlands, and Denmark.

### **2.9.3 Composting**

Composting, as defined by Thompson (2010), is the aerobic fermentation of organic household waste into fertilizer. Lawns, parks, and gardens all benefit from this fertilizer. Even though it is not widely used, composting is a safe and effective way to dispose of trash in Accra. According to Dreschel (2001) and Thompson (2010), composting accounts for 10–15 percent of the daily rubbish hauled away.

From an environmental perspective, composting is superior to other methods of recycling biodegradable trash. But because composting is often seen as a disposal procedure rather than a producing activity, many big and little composting programs have fallen flat on their faces. Like every other aspect of manufacturing, marketing and product quality need your undivided attention. According to the Sanitation Connection (online), composting is more suited for the agriculture industry than the waste management sector. Composting, according to the United Nations Environment Programme (2009, quoted by Puopiel, 2010), is the alternative that, with

few exceptions, best fits within the restricted resources available in poor nations. The versatility of composting makes it a great option in many different contexts. Most compostable solid wastes are naturally putrescible and biodegrade quickly.

#### **2.9.4 Recycling**

Momoh and Oladebeye (2010: 1, quoted in Puopiel, 2010) argue that recycling is crucial since it both reduces the quantity of trash sent to landfills and supplies businesses with raw materials. They have concluded that recycling is the most advantageous strategy for dealing with garbage. The process of recycling transforms waste into usable resources that may be put to productive use in the economy. Natural resource conservation, energy conservation, pollution avoidance, economic growth, and competitiveness are all areas in which it pays off on several fronts for the environment, economy, and society. Additionally, a considerable part of waste includes valuable resources that may be recycled and utilized again as raw materials (USEPA, 1999 as referenced by Puopiel, 2010). These include metals, glass, paper, wood, and plastic.

Puopiel (2010) cites Kreith's (1994) belief that recycling is the most financially viable and practically feasible alternative for managing solid wastes. Not only does recycling keep trash out of landfills, but it also cuts down on the requirement for new materials to be mined and refined in the production of consumer goods (Srinivas, 2006). Despite its obvious benefits and potential as a resourceful strategy for decreasing the amount of trash sent to landfills, recycling is still largely unexplored in Ghana. Scavengers are only able to retrieve a small percentage of material from landfills, therefore huge amounts of trash continue to be dumped.

#### **2.9.5 Incineration**

Incineration is described as a controlled combustion process that converts combustible trash into gases and non-combustible residue (Centre for Environment and Development, 2003:9), as

referenced by Puopiel (2010). According to the Centre, the incineration process causes the solid waste's moisture to evaporate while also oxidizing and evaporating the combustible fraction. Incineration results in the production of carbon dioxide, water vapor, ash, and a non-combustible residue. The volume of solid wastes is reduced by incineration by 90%, while the weight is reduced by 75% (Tasantab, 2012). When garbage is incinerated, the heat is recovered and utilized for other purposes, such as heating swimming pools. There will always be waste left over after incineration, hence landfills are necessary (Tasantab, 2012).

Even while it reduces land pollution, he thinks incineration increases air pollution. This view was echoed by Puopiel, 2010 who said that incineration..... tends to harm the environment through carbon dioxide emissions.

#### **2.9.6 Sanitary landfill**

Waste disposal facilities are specially designed areas where solid wastes may be buried without endangering the local community. The hazards to people and animals from air, water, and soil pollution are reduced thanks to this method. Consideration is also given to how things look. The waste is arranged, compacted, and covered with care. The engineering, planning, and management that go into sanitary landfills set them apart from open dumps. Preventing dirty water (leachate) from leaking out of the landfill is a major consideration in most sanitary landfill designs. Even in semi-arid regions, landfills have been demonstrated to create significant volumes of leachate. Scheu (2001) was referenced in an article published by Sanitation Connection. Most plans call for draining systems to transport leachate to a treatment plant or storage tank and costly, meticulously built impermeable layers to stop leachate from seeping into the earth.

Landfills are one kind of waste management that no one really enjoys, but which is necessary for society as a whole (Kreith, 1994, as quoted in Puopiel, 2010). He goes on to say that no combination of waste management methods can function without resorting to land filling. Only landfills, out of the several choices for basic solid waste management, are both essential and adequate. He claims that certain wastes are not recyclable, that the inherent value of many recyclable wastes is depleted to the point that they can no longer be recovered, and that recycling itself creates residuals. Keep in mind that no matter how much effort is put into recycling, composting, and other forms of trash diversion, there will always be some garbage that must be disposed of in a landfill (Rainer, 1990, emphasis added).

The United States Agency for International Development (2009) reports that sanitary landfills have substantially higher operational expenses and need a much larger initial investment. It is crucial to get community input at every stage of the project's development. Even more technical prowess is needed for effective design, operation, and closure. As a result, they have proposed the following strategies for operating clean landfills:

**Siting:** The siting phase of landfill construction is among the most challenging.

No landfills shall be built within two kilometres of an airport, along geological faults or seismically active zones, in floodplains, or near sources of drinking water. However, clay deposits are a suitable location for them.

**Design:** To mitigate environmental impacts, sanitary landfill designs should include:

1. An impermeable or low-permeability lining (compacted clay and polyethylene are most common in developing countries; geopolymers and asphalt are prevalent in the developed world).

2. Leachate collection, monitoring, and treatment.
3. Gas monitoring, extraction, and treatment.
4. Fencing to control access.
5. Provisions for closure and post-closure monitoring and maintenance.

These guidelines will ensure that sanitary landfills are properly managed to forestall any potential surface and groundwater contamination; health and physical threats to waste pickers and sanitation workers; and methane emissions.

## **CHAPTER THREE**

### **3.0 METHODOLOGY**

#### **3.1 Introduction**

This chapter presents a brief description of the Municipality in terms of the physical features, social structure, population size, and socio-economic activities. It also discussed the materials and methods used for the data collection.

#### **3.2 Study Area**

The Nsawam Adoagyiri Municipality is located approximately 23km from Accra, the capital city of Ghana. The Municipality is located in the southeastern part of the Eastern Region, with latitude ranging from 5'.45 N to 5'.58 N and longitude ranging from 0.07' W to 0.27' W. The Municipality spans approximately 175 square kilometres, constituting a portion of the overall Eastern Region area. The municipality is adjacent to the Greater Accra Region and shares borders with the Akuapem North Municipality to the north, the Suhum Municipality to the west, and the Upper West Akim District.

The relief of the Municipality can be classified into three main divisions: Densu plains, Ponpon narrows land, and Akuapem-Togo ranges. The Densu plains, located in the western half of the municipality, consist of undulating terrain with occasional isolated peaks. Notable peaks include Amama hill and Nyanao hill, which have elevations of approximately 5000 feet and 1000 feet above sea level, respectively. The municipality is drained by the Densu River and its tributaries, including the Ntua, Pompom, Ahumfra, and Dobro.

The region experiences an average annual precipitation ranging from 125cm to 200cm. The initial rainy season typically occurs from May to June, with the highest precipitation occurring in June. There is also a second rainy season from September to October. The temperature in the area reaches its peak at 30°C during the months of March and April, while it drops to its lowest point at 26°C in August.

According to the 2010 Population and Housing Census, the population of Nsawam Adoagyiri Municipal is 86,000, accounting for 3.3 percent of the total population of the Eastern region, which is 2,633,154. The district's population is comprised of 49.7% males and 50.3% females. The majority (59.1%) of the district's population resides in urban areas. The district has a youthful population with slightly more than one third (34.3%) of the population below 15 years.

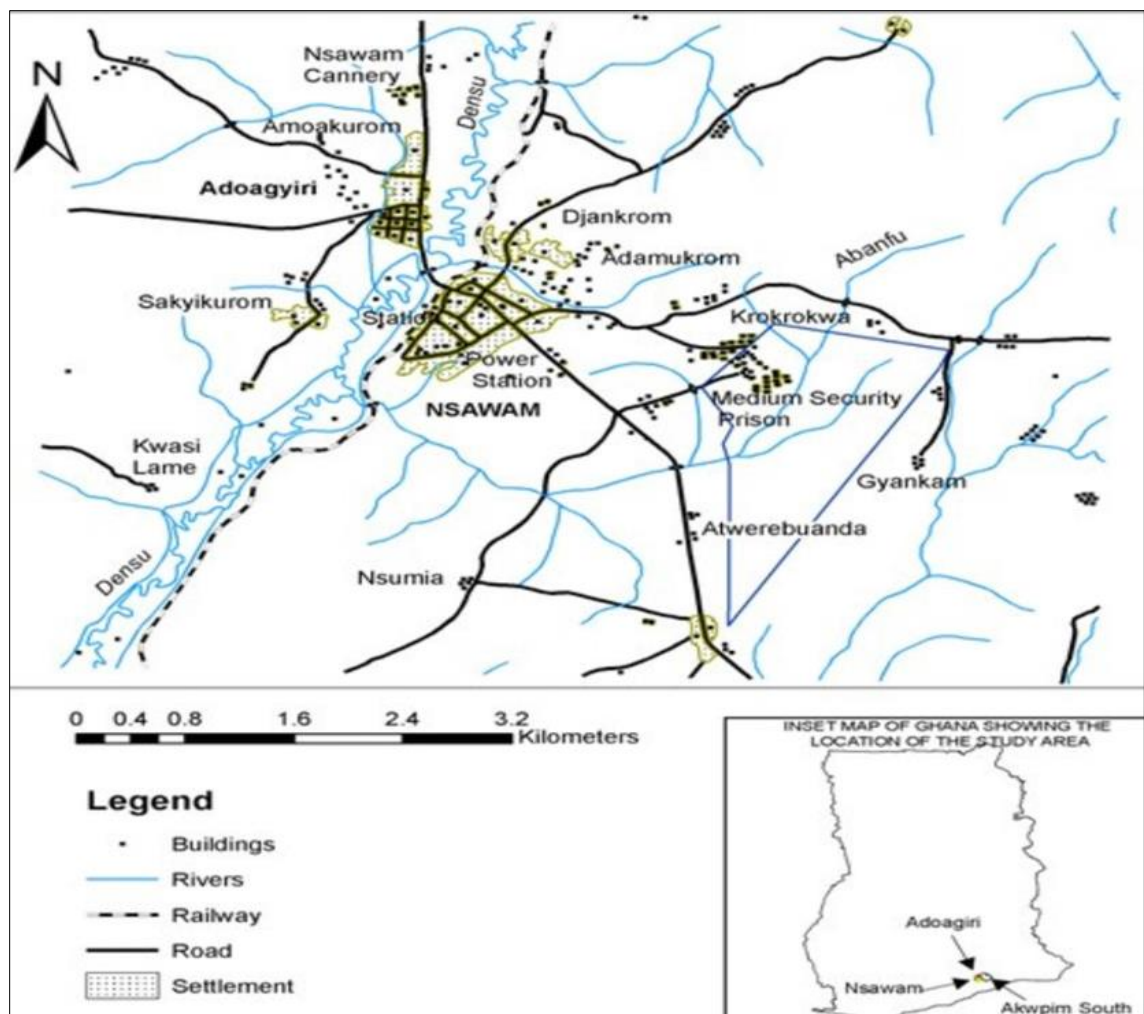


Figure 3.3 Map showing the study area (Nsawam Adoagyiri Municipality)

Source: Ghana Statistics Authority (2020)

### 3.4 Method

#### 3.4.1 Data collection

Primary data was obtained from the field through various data collection techniques, including questionnaire survey, interviews, and field observation. Semi-structured questionnaires was designed and administered to 100 households respondents).

#### 3.4.2 Use of Questionnaire

The questionnaire was structured into four parts: demography of respondents, solid waste management practices, disposal methods adopted and reasons for adopting that method, impacts of solid waste on community river bodies. Five major towns in the municipal were selected and



20 household heads from each town were conveniently selected and administered with the questionnaire.

### **3.4.3 Data analyses**

SPSS software was used to analyze the data collected from the 100 respondents. The data was coded and entered into the statistical package before running all necessary analyses. Results of the analyses were presented in descriptive form as well as pie charts, and bar graphs.

## **CHAPTER FOUR**

### **4.0 RESULTS AND DISCUSSION**

#### **4.1 Introduction**

This chapter presents the results of the study based on the field data collected and discuss these findings in relation to previous studies on the subject. More specifically, the chapter presents the results of the following: demography of the respondents, waste management practices and its challenges, and the impacts of waste on community rivers.

## 4.2 Socio-Demographic Data

The participants' demographic data is presented in the table 4.1 below. As can be seen from the table, 60.0% of the participants were males 40.0% were females. 39.0% of the participants were between 20-29 years, 25.0% were between 30-39 years, 19.0% between 40-49 years, 9.0% were between 50-59 years and 8.0% of the remaining were also 60 years and above. The data also shows that 29.0% of the participants lived in a household containing 1-3 people, 37.0% lived in a household containing 4-6 people, 21.0% lived in a household containing 7-9 people and 13.0% also lived in a household containing 10 people and above. Also, 8.0% of the participants do not have any education background, 15.0% had primary school education, 19.0% had middle school/JSS education, 25.0% had SHS/Technical education, 20.0% had tertiary education and 13.0% also had non formal education. Again, the data shows that 22.0% of the participants were unemployed, 20.0% were part-time employees, 16.0% were full-time employees, 16.0% were retired, 16.0% were also entrepreneurs and the remaining 10.0% were also students.

**Table 4.1: Socio-Demographic Data**

<b>Variables</b>	<b>Frequency</b>	<b>Percent</b>
<i>Gender of the respondents</i>		
Male	60	60.0
Female	40	40.0

<b>Total</b>	<b>100</b>	<b>100%</b>
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*Age of the Respondents*

20-29	39	39.0
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30-39	25	25.0
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40-49	19	19.0
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50-59	9	9.0
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60 and above	8	8.0
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<b>Total</b>	<b>100</b>	<b>100%</b>
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*Household Size*

1-3	29	29.0
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4-6	37	37.0
-----	----	------

7-9	21	21.0
-----	----	------

10 and above	13	13.0
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<b>Total</b>	<b>100</b>	<b>100%</b>
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*Educational level attained*

Never	8	8.0
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Primary	15	15.0
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Middle school/JSS	19	19.0
-------------------	----	------

SHS/Technical	25	25.0
Tertiary	20	20.0
Non formal	13	13.0
<b>Total</b>	<b>100</b>	<b>100%</b>

***Employment status***

Unemployed	22	22.0
Part-time employee	20	20.0
Full-time employee	16	16.0
Retired	16	16.0
Entrepreneur	16	16.0
Student	10	10.0
<b>Total</b>	<b>100</b>	<b>100%</b>

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**4.3 Assessment of Solid Waste Management Practices in the Municipal**

This section presents results on the assessment of how households dispose solid waste. Descriptive statistics (frequency, percentages and graphs) were used to make deductions and inferences on how the household dispose their solid waste.

### 4.3.1 Known Solid Waste Management Systems in the Community

In this section, the participants were asked to indicate how solid waste is managed in their community. The results are shown in the table 4.2 below. From the results, 81.0% representing majority of the participants indicated that in the community, door-to-door waste collection is the method of waste management, 14.0% indicated that the community do not engage in door-to-door waste collection while 5.0% also indicated that they are not sure as to whether door-to-door waste collection is done in the community or not. (Teerioja et al., 2012) Also, majority (57.0%) of the participants indicated that there is a community-led waste collection drive in the community, 29.0% indicated there is no community-led waste collection drive while 14.0% were also not sure whether there is a community-led waste collection drive. From the results also, majority of the participants (54.0%) agreed that solid waste is managed in the community through the use of public waste bins, 35.0% indicated no, while 11.0% also indicated that they are not sure as whether the community use public waste bins or not (Botti et al., 2020). Also, 48.0% representing majority of the participants indicated that informal waste pickers/recyclers collect waste in the community, 37.0% indicated that informal waste pickers/recyclers are not in the community and 15.0% were also not sure if the community engage in informal waste picking/recycling. Again, 55.0% representing majority of the participants agreed that waste burning is done in the community, 30.0% do not agree and 15.0% were not sure. Again, majority (50.0%) indicated that the community engage in open dumping, 26.0% indicated that the community do not engage in open dumping and 24.0% also indicated that they are not sure if the community engage in waste open waste dumping or not (Degli et al., 2023).

**Table 4.2: *How is solid waste managed in your community***

<b>Statement</b>	<b>Frequency</b>	<b>Percent</b>
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***Door-to-door waste collection by the municipality***

Yes	81	81.0
No	14	14.0
Not sure	5	5.0

***Community-led waste collection drive***

Yes	57	57.0
No	29	29.0
Not sure	14	14.0

***Use of public waste bins***

Yes	54	54.0
No	35	35.0
Not sure	11	11.0

***Informal waste pickers/recyclers***

Yes	48	48.0
No	37	37.0
Not sure	15	15.0

***Burning***

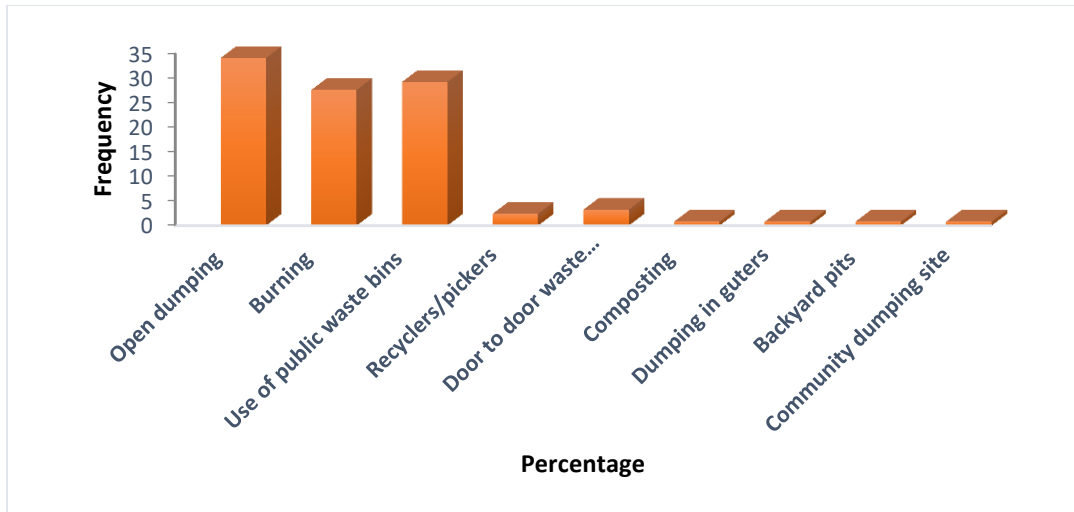
Yes	55	55.0
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No	30	30.0
Not sure	15	15.0
<b><i>Open dumping</i></b>		
Yes	50	50.0
No	26	26.0
Not sure	24	24.0
<b><i>Total</i></b>	<b><i>100</i></b>	<b><i>100.0</i></b>

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#### **4.3.2 Domestic Solid Waste Disposal Method by Households**

The participants were asked to indicate their domestic solid waste disposal method, as can be seen from the figure 4.2, 34.1% representing the majority of the respondents indicated they use the open dumping method, 27.6% indicated burning method, 29.3% indicated they use the public waste bins, 2.4% indicated recyclers/pickers, 3.3% indicated door to door waste collection, 0.8% indicated composting method, dumping in gutters, backyard pits and community dumping site (Mohan & Joseph, 2021).

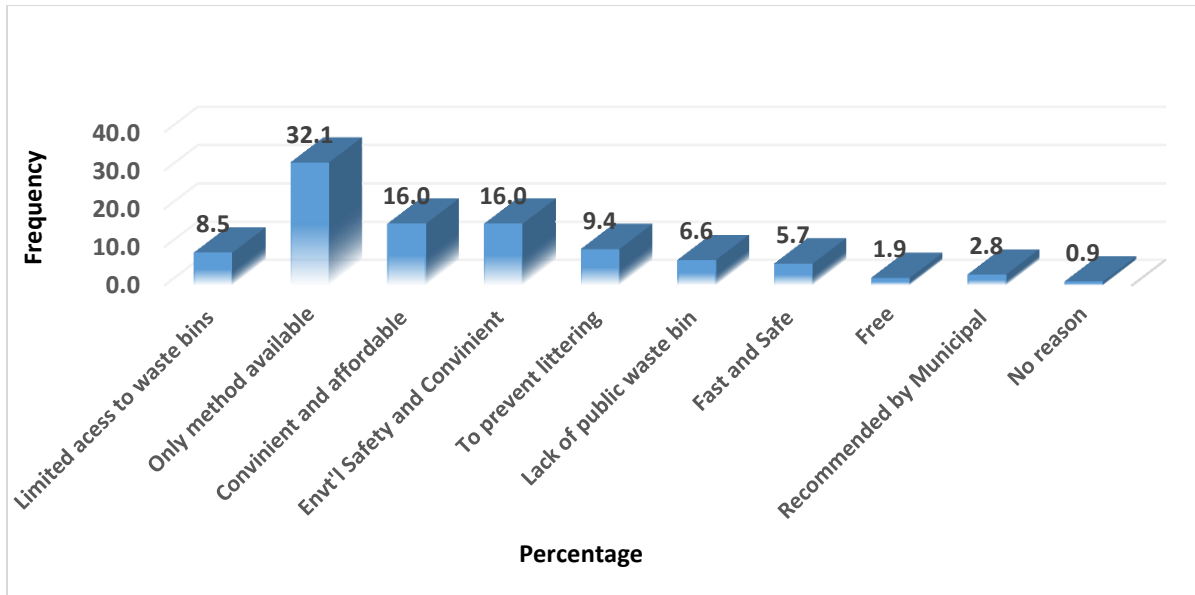


**Figure 4.1: Disposal Method**

#### **4.3.3 Reasons for the Disposal Method Chosen**

The participants were also asked to specify their reason for chosen a particular disposal method. The graph showed that 8.5% of the participants use a particular disposal method because of limited access to waste bins, 32.1% representing majority of the participants indicated they use the public waste bin because it is the only available method, 16.0% indicated because of the convenience and affordability of the open dumping, 9.4% also dispose it to prevent littering, 6.6% dispose because of lack of waste bins, 5.7% also indicated because it is fast and safety, 1.9% indicated because it is free, 2.8% indicated because it is recommended by municipal and 0.9% also indicated it is no reason (Arebey et al., 2011).

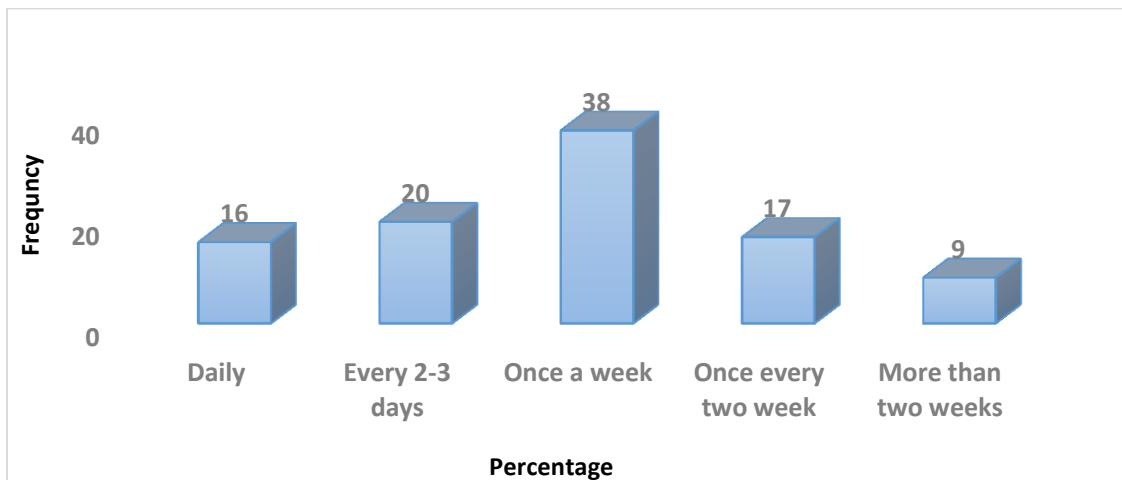




**Figure 4.2: Reasons for Disposal Method Chosen**

#### 4.3.4 Frequency of Solid Waste Collection

The participants were also asked to indicate how frequently solid waste is collected from the storage points in the community. As can be seen in the figure 4.3, 16.0% of the participants indicated daily, 20.0% indicated every 2-3 days, 38.0% representing majority of the participants also indicated once a week, 17.0% indicated once every two weeks and 9.0% indicated more than two weeks (Kapepula et al., 2007).



**Figure 4.3: how frequently is solid waste collected in your area**

The participants were further asked to specify if the wastes dump in public/company waste bins are picked up on time from the community to prevent environmental pollution. As shown in the table 4.3 below, 25.0% of the participants indicated wastes dump in public/company waste bins are picked up on time, 57.0% representing majority of the participants indicated wastes dump in public/company waste bins are not picked up on time and 18.0% also indicated that they are not too sure if wastes dump in public/company waste bins are picked up on time or not (Gebril et al., 2010).

#### **4.3.5 Segregation of Waste into Different Categories**

The participants were also asked to specify if they segregate their solid wastes into different categories (e.g., organic, recyclable, non-recyclable) before disposal. The results show that only 30.0% of the participants segregate their solid wastes into different categories (e.g., organic, recyclable, non-recyclable) before disposal, while majority (60.0%) do not segregate their solid wastes into different categories before disposal and 10.0% also not sure if they segregate their solid wastes into different categories before disposal or not (Fredrick et al., 2018).

#### **4.3.7 Designated Recycling Centers**

The participants were also asked to provide if there are designated recycling centers in the community. As shown the table 4.3, only 16.0% of them indicated there is a designated recycling centers in the community, 28.0% indicated there is no designated recycling centers in the community while, 56.0% representing majority indicated they are not sure whether there is a designated recycling centers in the community or not (Jenkins et al., 2023).

#### 4.3.8 Hazardous waste Disposal

Data was also collected on the participants disposal of hazardous waste. The results in the table 4.3 shows that 19.0% dispose of hazardous waste through designated drop-off points, 75.0% representing majority dispose of hazardous waste by mixing it with regular waste and 6.0% also dispose of it using other means.

#### 4.3.9 Paying Money for Disposing Waste

The participants were also asked to indicate if they are required to pay money for disposing of their waste. As shown in the table 4.3, majority (82.0%) said they are required to pay money for disposing of their waste while 18.0% also said they are not required to pay money for disposing of their waste.

**Table 4.3: Waste Dump, Segregation, Dispose of Hazardous Waste and Money Paid for Disposing Waste**

Statement	Frequency	Percent
<i>Do the wastes dump in public/company waste bins are picked up on time from the community and do not overstay to cause environmental pollution before they are finally dispose of by the responsible institutions</i>		
Yes	25	25.0
No	57	57.0
Not sure	18	18.0
<i>Do you segregate your solid wastes into different categories (e.g., organic, recyclable, non-recyclable) before disposal</i>		
Yes	30	30.0
No	60	60.0

Not sure	10	10.0
----------	----	------

***Are there designated recycling centers in your community***

Yes	16	16.0
-----	----	------

No	28	28.0
----	----	------

Not sure	56	56.0
----------	----	------

***How do you dispose of hazardous waste (e.g., batteries, electronic waste) in your household?***

Through designated drop-off points	19	19.0
------------------------------------	----	------

Mixed with regular waste	75	75.0
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Other (please specify)	6	6.0
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***Are you required to pay money for disposing of your waste?***

Yes	82	82.0
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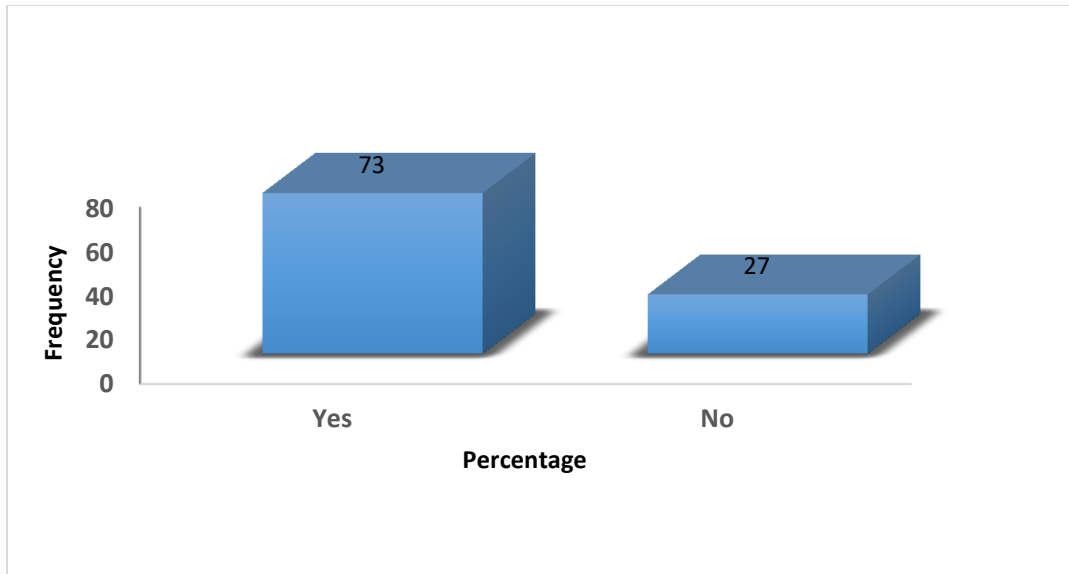
No	18	18.0
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<b><i>Total</i></b>	<b><i>100</i></b>	<b><i>100.0</i></b>
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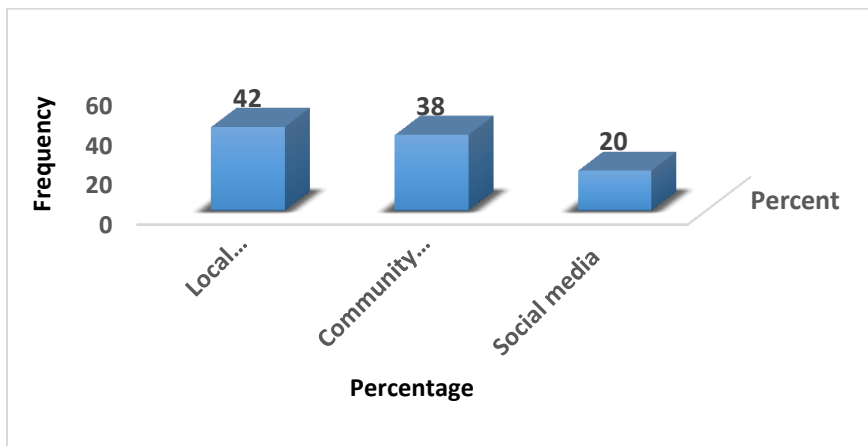
#### **4.4 Proper Solid Waste Management Initiatives**

Data was captured on whether they have ever received information or education on proper solid waste management practices. The results in the figure 4.4 shows that 73.0% representing majority of the participants have ever received information or education on proper solid waste management practices, while 27.0% have not received information on proper solid waste management practices (Agarwal et al., 2015).



**Figure 4.4: Have you ever received information or education on proper solid waste management practices**

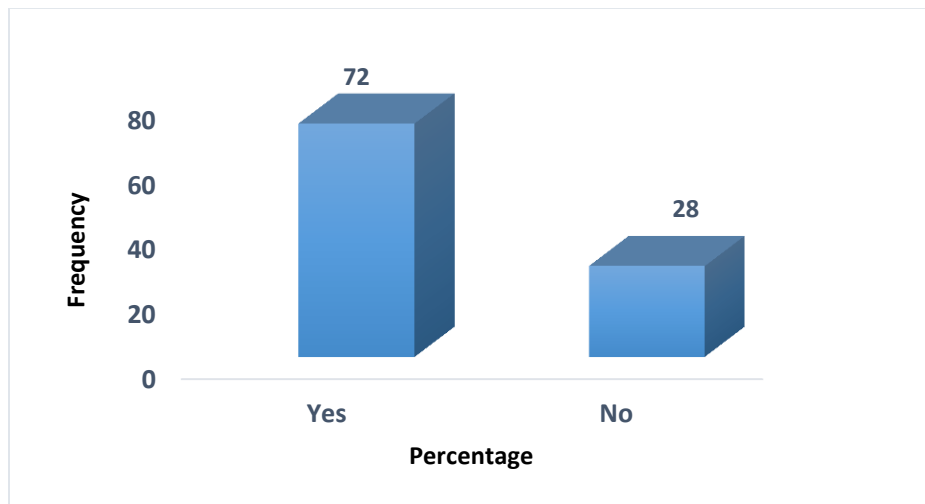
The participants were also asked to indicate how they stay informed about waste management practices and initiatives in their community. As can be seen in the figure 4.4, majority (42.0%) indicated they stay informed through local government announcement, 38.0% indicated through community meetings or events and 20.0% also indicated through social media (Mwiinga, 2015).



**Figure 4.5: How do you stay informed about waste management practices and initiatives in your community**

#### 4.5 Impact of Solid Waste on Community Rivers

Information was also gathered on whether there is any river or water body near the community that is affected by waste dumping or runoff. As shown in the figure 4.6, 72.0% representing majority specified that there is a river or water body near the community that is affected by waste dumping or runoff while 28.0% specified that there is no river or water body near the community that is affected by waste dumping or runoff (Butu et al. 2020).



**Figure 4.6: Is there a river or water body near your community that is affected by waste dumping or runoff**

Again, the participants also provided information on whether they have personally observed solid waste in or near the community river. The results in the table 4.4 below shows that 77.0% representing majority of the participants have personally observed solid waste in or near the community river while 23.0% have not.





**Plate 4.1: Refuse dump sited at the river bank**



**Plate 4.2: Field observation of the use of community river as solid waste dumping site.**

#### 4.5.1 Main sources of solid waste that end up in the community river

The participants were also asked to indicate in their opinion what they think are the main sources of solid waste that end up in the community river. As can be seen from the results, majority (51.0%) of the participants indicated that improper waste disposal by residents is the main sources of solid waste that end up in the community river, 30.0% indicated littering and dumping by visitors and 19.0% also indicated waste discharge from industries (Wynne et al., 2018).

#### 4.6. Community-led initiatives to Clean up the Community River and its Surroundings

The participants were also asked to provide if there are any community-led initiatives or programs to clean up the community river and its surroundings. From the results 42.0% of the participants indicated yes while majority (58.0%) indicated no. The participants also provided information on whether they have ever participated in community clean-up events focused on the river. The results showed that 62.0% representing majority have ever participated while 38.0% have not participated in any community clean-up event.

**Table 4.4: Community River Solid Waste Assessment and Cleanup Initiatives**

<b>Variables</b>	<b>Frequency</b>	<b>Percent</b>
<i>Have you personally observed solid waste in or near the community river?</i>		
Yes	77	77.0
No	23	23.0
<i>In your opinion, what are the main sources of solid waste that end up in the community river?</i>		
Improper waste disposal by	51	51.0



residents

Littering and dumping by	30	30.0
--------------------------	----	------

visitors

Waste discharge from industries	19	19.0
---------------------------------	----	------

*Are there any community-led initiatives or programs to clean up the community river and its surroundings*

Yes	42	42.0
-----	----	------

No	58	58.0
----	----	------

*Have you ever participated in a community clean-up event focused on the river*

Yes	62	62.0
-----	----	------

No	38	38.0
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<b>Total</b>	<b>100</b>	<b>100.0</b>
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#### **4.4 Discussion of Results**

The aim of this study was to assess the waste management practices and their impacts on community rivers in the Nsawam Adoagyiri municipality. Therefore, the discussion of the results is presented according to the research objectives.

#### **4.4.2 Current Households Waste Disposal Practices in the Municipality**

The second objective set to assess the current households waste disposal practices in the municipality. The study revealed that only 25.0% of participants indicated that wastes deposited in public or company waste bins are collected on time, while the majority (57.0%) reported that such wastes are not promptly collected. The findings suggest that there might be a notable problem with the punctuality of waste collection services in the municipality. Delays in waste pickup can lead to overflowing bins, littering, and environmental pollution. Additionally, they can have a negative impact on public health and the overall aesthetics of the community. Improving waste collection efficiency and scheduling could address this problem and enhance the overall waste management system of the municipality.

#### **4.4.3 Frequency of solid waste collection**

The objective three set to analyze frequency of solid waste collection. The findings of the study, which uncover a discrepancy in the frequency of waste collection within the community, raise concerns regarding the reliability and effectiveness of waste management services. The results indicate potential disparities in waste management services, with only 16.0% of participants reporting daily solid waste collection and a larger portion (38.0%) indicating once-a-week collection as the most common frequency. The findings align with the existing literature on waste management, highlighting the significance of fair and consistent waste collection schedules in mitigating the risk of environmental pollution (Kumar et al., 2017). Inconsistencies in waste collection frequency can result in inconsistent waste removal, heightened littering, and potential environmental hazards (Gupta et al., 2016).

#### **4.4.4 Proper Solid Waste Disposal**

The findings of the study highlight several crucial issues in the field of waste management within the municipality. The relatively low percentage (30.0%) of participants who reported segregating solid waste into different categories before disposal emphasizes the importance of raising awareness and implementing waste sorting practices. These practices have been proven to be crucial in waste reduction and the promotion of recycling (Yadav & Samadder, 2018). Furthermore, the mere 19.0% of individuals who appropriately dispose of hazardous waste via designated drop-off points indicates a lack in the effective management of hazardous materials, which could potentially result in environmental and health hazards (Baldé et al., 2015). The overwhelming majority (82.0%) of individuals who mentioned the obligation to pay for waste disposal emphasized the financial burden placed on residents for waste management services. This highlights the need to address this issue through the implementation of more fair financing models and government support (Bilitewski et al., 1997). These findings collectively highlight the importance of education and awareness campaigns, the need for proper hazardous waste management infrastructure, and the implementation of fair financing mechanisms to improve waste management practices in the municipality.

#### **4.4.5 Measures to Control Inappropriate Households Waste Disposal Practices**

The findings indicated that a significant proportion of participants, specifically 73.0%, have received information or educated regarding proper solid waste management practices. Furthermore, 42.0% of individuals stay informed by means of local government announcements, while 38.0% rely on community meetings or events, and 20.0% utilize social media as their source of information. These findings suggest that the participants have a relatively high level of

awareness and access to information regarding proper waste management practices. In order to enhance waste disposal practices in the municipality, it is crucial to concentrate on utilizing the current channels for distributing information and further encouraging responsible waste management behaviors within the community.

## CHAPTER FIVE

### 5.0 CONCLUSION AND RECOMMENDATIONS

#### 5.1 Introduction

This last part of the study provides a summary of the findings as well as suggestions for areas that need more research. Both the overall scope of this research as well as its possible influence on studies to come in the future were taken into consideration.

#### 5.2 Conclusion

In conclusion, the study identifies six general waste management practices in the Nsawam Adoagyiri Municipal namely: door-to-door waste collection, community-led waste collection drive, use of public waste bins, informal wastes picking/recycling, waste burning and open dumping. From the findings, the primary waste management method, as highlighted by the majority of participants, is door-to-door waste collection, followed community-led waste collection drive, waste burning, public waste bin use, open dumping and informal waste picking/recycling.

The study revealed that only few of participants indicated that wastes deposited in public or company waste bins are collected on time, while the majority reported that such wastes are delayed before collected, causing overflowing bins, littering, and environmental pollution in the community. The results indicate a notable variation in the frequency of waste collection within the community where majority of respondent reported that solid wastes were commonly collected once-a-week in the community. By addressing these disparities and ensuring more equitable waste collection schedules, one can enhance waste management efficiency and mitigate the risk of environmental pollution in the municipality.

The findings revealed that only a small percentage of participants reported segregating their solid waste into different categories before disposal. This indicates a need for increased awareness and implementation of waste sorting practices. Furthermore, a mere number of individuals appropriately disposed of hazardous waste by utilizing designated drop-off points. This suggests that the widespread practices of proper hazardous material disposal may be lacking. Also, an overwhelming majority mentioned the obligation to pay for waste disposal, emphasizing the financial strain imposed on residents for waste management services.

The findings indicated that a significant proportion of participants, have been educated on proper solid waste management practices. Furthermore, majority of individuals stay informed by means of local government announcements, while some individuals rely on community meetings or events, others also utilize social media as their source of information. These findings suggest that the participants have a relatively high level of awareness and access to information regarding proper waste management practices.

Also, the study reveals that individuals use the community river side as waste dumping site which has affected the quality of the water and it life forms.

### **5.3 Recommendations**

Based on the findings, the recommendations below are suggested.

- The municipality of Nsawam Adoagyiri should invest in improving rubbish collection services to guarantee timely and effective pickup. This advice is the responsibility of the Municipal Waste Management Department, in collaboration with local government authorities. They should distribute resources, enhance logistics, and design a garbage collection timetable that is effective.

- Create a standardized garbage collection schedule for the whole municipality in order to offer fair service to all households. The municipal council and waste management department should work together to develop and implement a regular garbage collection schedule.
- Launch thorough public awareness programs to promote trash separation at the source and appropriate hazardous waste disposal. These awareness efforts should be led by the Environmental Protection Agency (EPA) or a comparable environmental regulatory entity, in collaboration with local NGOs, community organizations, and educational institutions.
- Consider fee restructuring, subsidies for low-income families, or incentives for recycling initiatives to reduce the financial load on residents for waste management services. The Nsawam Adoagyiri municipal council and finance department should study and implement adjustments to the fee system and subsidy programs, with input from community leaders and stakeholders.
- Enhance enforcement of waste management regulations, including fines and penalties for illegal dumping or littering near the river.
- Encourage river clean-up activities through organized events and volunteer programs.

## REFERENCES

- Abdus-Salam, N., Ibrahim, M. S. & Fatoyinbo, F. T. (2011). A Silent Pollution Zone for Underground Water. *Waste Management and Bioresource Technology, 1, 21-30*
- Assembly, A. M. (2006). Accra metropolitan assembly.
- Agarwal, R., Chaudhary, M., & Singh, J. (2015). Waste management initiatives in India for human well being. *European Scientific Journal*.
- Ankra, R. A. (2019). Assessment of Solid Waste Management among Households. *Presbyterian University College*.
- Arebey, M., Hannan, M. A., Basri, H., Begum, R. A., & Abdullah, H. (2011). Integrated technologies for solid waste bin monitoring system. *Environmental monitoring and assessment, 177, 399-408*.
- Baldé, C. P., Forti, V., Gray, V., Kuehr, R., & Stegmann, P. (2015). The Global E-waste Monitor – 2014. United Nations University, IAS – SCYCLE. Bonn, Germany.
- Bilitewski, B., Hrabovszky, J., & Dierkes, C. (1997). Waste management in Germany. *Waste Management, 17(6), 423-432*.
- Boakye, R. (2012). Impact of waste on urban surface water resources. *Kwame Nkrumah University of Science and Technology*.
- Bogner, J., Abdelrafie Ahmed, M., Diaz, C., Faaij, A., Gao, Q., Hashimoto, S., ... & Wellinger, A. (2007). Waste management. In *Climate change 2007: Mitigation (pp. 585-618)*. IPCC.



- Botti, L., Battini, D., Sgarbossa, F., & Mora, C. (2020). Door-to-door waste collection: analysis and recommendations for improving ergonomics in an Italian case study. *Waste Management, 109*, 149-160.
- Bowan, A. P., & Mumuni, I. A. (2013). Assessment of Zoomlion's Approach to Waste
- Buabeng J. (2020). Managing of Plastic waste at Nsawam Adoagyiri Municipality. *Kwame Nkrumah University of Science and Technology*.
- Butt, L., & Labal, A. (2007). Solidwaste Management and associated Environmental Issues. *Journal of Social Science and Humanities, 62(1)*, 369-378
- Butu, A. W., Emeribe, C. N., Ogungbade, O. M., & Ananya, B. J. (2020). The impacts of poor solid waste management practices on Ala river water quality in Akure, Nigeria. *Global Journal of Earth and Environmental Science, 5(2)*, 37-50.
- Damodharan, U. (2013). Bioaccumulation of heavy metals on contaminated river water. *Uppanar, Cuddalore South East Cost of India*.
- Degli Esposti, A., Magrini, C., & Bonoli, A. (2023). Door-to-door waste collection: A framework for the socio-Economic evaluation and ergonomics optimisation. *Waste Management, 156*, 130-138.
- Environmental Protection Agency (2002). Manual for the preparation of District Waste Management Plans.
- Fredrick, M., Oonyu, J. C., & Sentongo, J. (2018). Influence of education on the solid waste management practices of communities in Kampala city. *J. Environ. Waste Manag, 5(1)*, 261-274.

- Gebril, A. O., Omran, A., Pakir, A. H. K., & Aziz, H. A. (2010). Municipal solid waste management in Benghazi (LIBYA): Current practices and challenges. *Environmental Engineering & Management Journal (EEMJ)*, 9(9).
- Ghana Statistical Service, (2010). Ghana Population & Housing Census.
- Gupta, N., Yadav, K. K., & Kumar, V. (2016). A review of waste management practices and their impact on human health. *World Journal of Pharmacy and Pharmaceutical Sciences*, 5(9), 170-181.
- Jenkins, R. R., Martinez, S. A., Palmer, K., & Podolsky, M. J. (2003). The determinants of household recycling: a material-specific analysis of recycling program features and unit pricing. *Journal of environmental economics and management*, 45(2), 294-318.
- Kapepula, K. M., Colson, G., Sabri, K., & Thonart, P. (2007). A multiple criteria analysis for household solid waste management in the urban community of Dakar. *Waste Management*, 27(11), 1690-1705.
- Kumar, S., Smith, S. R., Fowler, G., Velis, C., Kumar, S. J., Arya, S., ... & Cheeseman, C. (2017). Challenges and opportunities associated with waste management in India. *Royal Society open science*, 4(3), 160764.
- Lissah, et al, ( 2021). Managing Urban Solid waste in Ghana: Perspectives and Experiences of Municipal waste company managers and Supervisors in Urban Municipality. *Management. Journal of Environment and Earth Science*.

- Majeed, M., Owusu-Ansah, M., & Ashmond, A. A. (2021). The influence of social media on purchase intention: The mediating role of brand equity. *Cogent Business & Management*, 8(1), 1944008.
- Medina, M. (2011). Scavenger cooperatives in Asia and Latin America. Waste picker organizations, their contribution to solid waste management, and their role in the green economy. *Wiego Working Paper (Urban Policies) No. 29*.
- Moh, S. (2012). Field Investigation of Groundwater Contamination from Solid Waste Dumping Site. *International Journal of Civil & Environmental Engineering*, 12(02), 74-81.
- Mohan, S., & Joseph, C. P. (2021). Potential hazards due to municipal solid waste open dumping in India. *Journal of the Indian Institute of Science*, 101(4), 523-536.
- Mwiinga, F. (2015). *Preceptions of Solid Waste Management and the role of environmental education among selected residents of Choma Township of Southern Zambia* (Doctoral dissertation).
- Nabegu, A.B. (2010). An Analysis of Municipal Solid Waste in Kano Metropolis, Nigeria. *Journal of Human Ecology*, 31, 111-119.
- Nagabooshnam, J.K. (2011). Solid Waste Generation and Composition in Gaborone, Botswana, Potential for Resource Recovery. *Master Thesis, Department of Management Engineering, Linkoping University, Sweden*.
- Nyandwaro, N. E. (2017). The impacts of solid waste on ground and surface water quality. *B.Env. Studies, Kenyatta University, ICAP/II Colombo ICCE*.

- Okot-Okumu, J. (2012) Solid Waste Management in African Cities—East Africa, Waste Management—*An Integrated Vision. InTech*
- Osu, C., & Okoro, I. A. (2011). Comparative evaluation of physical and chemical parameters of sewage from some selected areas in Port Harcourt Metropolis, Rivers State Nigeria. *Continental Journal. Water, Air and soil pollution*, 2(1).
- Puopiel, F. (2010). ‘Solid Waste Management in Ghana, the case of Tamale Metropolitan Area’, *MSc Thesis, Kwame Nkrumah University Science and Technology, Kumasi- Ghana.*
- Sanitation Connection (2002). ‘Introduction to Solid Waste Management,’ *SKAT, Date accessed (May, 2011).*
- Srinivas, H. (2006). ‘Solid Waste Management’, *http://www.gdrc.org/eum/waste. Date accessed (May, 2011).*
- Tasantab J. (2012). Solid Waste Management In Ghanaian Towns. *Kwame Nkrumah University of Science and Technology.*
- Teerioja, N., Moliis, K., Kuvaja, E., Ollikainen, M., Punkkinen, H., & Merta, E. (2012). Pneumatic vs. door-to-door waste collection systems in existing urban areas: a comparison of economic performance. *Waste Management*, 32(10), 1782-1791.
- Thompson, A. A (2010). ‘Domestic Solid Waste Management Strategies in Accra, Ghana and other Tropical Developing Nations’. *Date accessed (May, 2011).*
- United Nations Environment Programme (2005). Solid Waste Management, Division of Technology, Industry, and Economics.

- Wilson, D. C. (2017). Community-based approaches to solid waste management in low and middle-income countries: A review of experiences. *World Bank Publications*.
- Wynne, A. L., Nieves, P. M., Vulava, V. M., Qirko, H. N., & Callahan, T. J. (2018). A community-based approach to solid waste management for riverine and coastal resource sustainability in the Philippines. *Ocean & Coastal Management, 151*, 36-44.
- Yadav, M., & Samadder, S. R. (2018). A review on technological options of waste to energy for effective management of municipal solid waste. *Waste Management, 79*, 44-59.
- Zerbock, O. (2003). Urban solid waste management: Waste reduction in developing nations. *Written for the Requirements of CE, 5993*.

## APPENDICES

### APPENDIX I: QUESTIONNAIRE

#### KOFORIDUA TECHNICAL UNIVERSITY

#### FACULTY OF BUILT AND NATURAL ENVIRONMENT

#### DEPARTMENT OF ENVIRONMENTAL MANAGEMENT AND TECHNOLOGY

#### SURVEY QUESTIONNAIRE

This questionnaire survey is part of an academic study to investigate “**Waste management practices and impacts on community rivers in the Nsawam Adoagyiri Municipality**”, for partial fulfillment of the requirement of Bachelor of Technology in Environmental Management and Technology in the Koforidua Technical University. I therefore seek your assistance to complete this questionnaire. I wish to highlight that this survey is for academic purpose only and your responses will be handled *confidentially* and *anonymously*. I also entreat that you *patiently* answer this questions with *much sincerity*. Thank you.

#### Definition of Waste Management:

*Please select the appropriate response from the options provided or supply the necessary information for the questions below.*

#### SECTION A: SOCIO-DEMOGRAPHIC DATA

1. Sex: a. Male [ ] b. Female [ ]

2. Age: a. 20-29 [ ] b. 30-39 [ ] c. 40-49 [ ] d. 50-59 [ ] e. 60 and above [ ]

3. Household Size: a. 1-3 [ ] b. 4-6 [ ] c. 7-9 [ ] d. 10 and above [ ]

4. Educational level attained: a. Never [ ] b. Primary [ ] c. Middle school/JSS [ ]

d. SHS/Technical e. Tertiary [ ] f. Non formal [ ]

5. Employment status: a. Unemployed [ ] b. Part-time employee [ ]

c. Full-time employee [ ] d. Retired [ ] e. Entrepreneur [ ] f. Student [ ]

**SECTION B: Assessment of how households dispose solid waste.**

6. How is solid waste managed in your community? (Select all that apply)

Management method	Yes	No	Not sure
Door-to-door waste collection by the municipality			
Community-led waste collection drives			
Use of public waste bins			
Informal waste pickers/recyclers			
Burning			
Open dumping			
Other (please specify)			

7. How do you dispose of solid waste generated in your home/ premises?

.....  
.....

8. What is/are your reason(s) for the choice of solid waste disposal method?

.....

9. On average, how frequently is solid waste collected in your area?

a. Daily [ ] b. Every 2-3 days [ ] c. Once a week [ ] d. Once every two week [ ]

More than two weeks [ ]

10. Do the wastes dump in public/company waste bins are picked up on time from the community and do not overstay to cause environmental pollution before they are finally dispose of by the responsible institutions? a. Yes [ ] b. No [ ] c. Not sure [ ]

11. Do you segregate your solid wastes into different categories (e.g., organic, recyclable, non-recyclable) before disposal? a. Yes [ ] b. No [ ]

12. Are there designated recycling centers in your community? a. Yes [ ] b. No [ ]

c. Not sure [ ]

13. How do you dispose of hazardous waste (e.g., batteries, electronic waste) in your household?

a. Through designated drop-off points [ ]

b. Mixed with regular waste [ ]

c. Other (please specify) .....

14. Are you required to pay money for disposing of your waste? a. Yes [ ] b. No [ ]

14. If yes, how much do you normally pay? .....

15. Which institutions/companies are responsible for waste collection in the municipality?

.....

16. Have you ever received information or education on proper solid waste management practices? a. Yes [ ] b. No [ ]

17. How do you stay informed about waste management practices and initiatives in your community?



a. Local government announcements [  ]

b. Community meetings or events [  ]

c. Social media [  ]

Other (please specify).....

18. Is there a river or water body near your community that is affected by waste dumping or runoff? a. Yes [  ] b. No [  ]

19. Have you personally observed solid waste in or near the community river? a. Yes [  ]

b. No [  ]

20. In your opinion, what are the main sources of solid waste that end up in the community river?

a. Improper waste disposal by residents [  ]

b. Littering and dumping by visitors [  ]

c. Waste discharge from industries [  ]

d. Other (please specify).....

21. Are there any community-led initiatives or programs to clean up the community river and its surroundings? a. Yes [  ] b. No [  ]

22. Have you ever participated in a community clean-up event focused on the river? a. Yes [  ]

b. No [  ]

23. In your opinion, what more can be done to improve solid waste management and prevent waste from entering the community river?.....

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