ASHESI UNIVERSITY

RECYCLING AS A STRATEGY FOR REVENUE GENERATION AND MUNICIPAL PLASTIC WASTE MANAGEMENT: THE CASE OF ACCRA METROPOLITAN AREA.

Undergraduate Thesis

By

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DECLARATION

I hereby declare that this thesis is the result of my own original work and that no part of it has been presented for another degree in this university or elsewhere.

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I hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by Ashesi University.

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ABSTRACT

The rapid growth of Accra and its associated increase in consumption have resulted in the generation of a large amount of solid waste, especially plastic waste. In fact, 300 metric tonnes of plastic waste is generated in Accra daily. However, only 5% of this waste is recycled. As a result, the Accra Metropolitan Assembly (AMA) is confronted with the problem of managing this waste as dumping, burning and the use of landfills are methods that are not environmentally sustainable.

The goal of this research was to explore the reasons for poor plastic waste disposal methods and the challenges it poses to residents in Accra. It also sought to determine to what extent plastic waste is presently recycled in Accra and the challenges facing recycling as a waste management strategy. This study further explored the strategic role played by recycling in promoting the management of plastic waste, employment and wealth creation in Accra. To accomplish the aim of the research, the qualitative approach was embraced for the collection and analysis of data. Primary data was gained from semi-structured interviews. The data was then examined using content analysis through themes.

From the findings, the recycling industry is currently underdeveloped and as at now, no association exists for recycling companies in Accra. The main problems that these companies that recycle encounter are lack of governmental support, apathetic attitude of the Ghanaian populace and the procurement and maintenance of equipment.

Keywords: plastic recycling, wealth, challenges, Accra

Table of Contents

LIST OF ABBREVIATIONS

AMA	Accra Metropolitan Assembly
ISWM	Integrated Solid Waste Management
GES	Ghana Educational Service
MMDAs	Metropolitan Municipal and District Assemblies
NCCE	National Commission for Civic Education
SDGs	Sustainable Development Goals
UN	United Nations
UNDP	United Nations Development Programme
USD	United States Dollars
UNICEF	United Nations International Children's Emergency Fund
WMD	Waste Management Department

LIST OF FIGURES

LIST OF DEFINITIONS

Liquid waste – any form of liquid residue that is harmful to the environment and people.

Municipality - a town or a district governed by a local government.

Plastic waste – plastic objects that are discarded and yet to be recycled.

Recycling – the process of reusing materials for the same product or another product.

Sachet water rubber – Plastic pouches or "sachets" in which cheap drinking water is sold.

Solid waste – any material that is solid and regarded as unwanted and is generated from human and animal activities.

Sustainable Development Goals – the compendium of seventeen worldwide goals generated to provide a blueprint for a sustainable environment.

Waste – anything that is considered to be of no use anymore.

Wealth – possessing abundance of money and valuable items.

*An exchange rate of 6 GHC/ $1USD was used for this study.

CHAPTER 1: INTRODUCTION

1.1 Introduction

Ghana, officially called the Republic of Ghana, is situated in West Africa. It is an independent state that is home to an estimated 30.42 million people. The largest and most inhabited city in Ghana is its national capital; Accra, with an estimated urban population of 2.27 million (World Population Review, 2019).

Accra covers an area of 67 square miles (World population review, 2019). It is one of the fastest growing cities in Africa and is the center for the country's cultural, administrative and economic activities (Knott, 2018). Accra is Ghana's main port city and attracts very high import volumes of goods which facilitates commercial activity. Traders and merchants from the northern, western and middle parts of the country bring goods to sell in Accra's busy open markets like the famous "Makola Market". Consumers from these same parts of Ghana as well as Accra's own domestic consumers actively shop and purchase imported goods from Accra's malls and markets. Due to the intense commercial activity, there are a lot of opportunities for employment in Accra. Therefore, as compared with other towns and villages, Accra is the first choice for labor seeking residents in Ghana (Annepu & Themelis, 2013).

As a haven for many economic activities, the choice destination of rural-urban migrants and the residence of a large urban population, it is hardly surprising that Accra churns out incessant quantities of solid waste especially plastic waste. According to Knott (2018), 2,000 metric tonnes of solid waste was generated daily in Accra in 2013. By 2018, Accra generated over 3,000 metric tonnes of solid waste every day. The annual estimation of 1,095,000 tonnes of solid waste generated is evidence of a burgeoning

problem. Of the solid waste generated in Accra, plastic waste constitutes about 17% (Miezah et al., 2015).

The increase in solid waste, has generated a concurrent increase in plastic waste which is as a result of rapid urbanization, population growth, intense rural-urban migration and rapid changes in material consumption outweighing the city's ability to process and contain them (Knott, 2018). The continuous increase in plastic waste generation in Accra has necessitated the need for its effective utilization through recycling. Recycling is useful not only for environmental protection but as an economic activity to generate wealth (Asokan, Saxena, & Asokeler, 2004). To further understand the problem of plastic waste, a background is provided below.

1.2 Background

According to Zerbeck (2003), solid waste refers to non–hazardous domestic, industrial and commercial waste. This includes garbage, rubbish and sludge that are non-liquid and non-gaseous wastes. In comparison, Charas (1998) defined solid waste as items such as discarded paper, leftover foods, plastic waste, human waste and metals from hospitals, schools, households, airports, stores and firms. Additionally, plastic waste comprises a wide range of synthetic or semi synthetic organic amorphous solid materials derived from oil and natural gas that are discarded and yet to be recycled (Jammu & Kashmir, 2012). For the purpose of this study, only the plastic waste component of solid waste will be considered. This is primarily due to its potential to generate wealth. Another reason for focusing on plastics is that they constitute a significant component of the total solid waste generated in Accra.

The process of collecting, treating, storing and transporting plastic materials discarded as waste is referred to as plastic waste management (LeBlanc, 2018). The goal of plastic waste management is to prevent the creation of unsanitary conditions and to protect public health. Besides the environmental benefits and the superior quality of life good waste management promotes, it prevents wasting national revenue on combating the consequences of poor plastic waste disposal. Some of these consequences include soil contamination, water contamination, climate change and the adverse effect on human health such as cholera, dysentery and leptospirosis (LeBlanc, 2018).

To manage plastic waste, recycling remains the best method because it is environmentally friendly, cost effective, conserves resources, saves energy and creates jobs. Although other solid waste management methods do exist, examples of which are sanitary landfills, incineration and composting, recycling has proven to be the most effective method of managing plastic waste (Zerbock, 2003).

Even though it is possible for some types of solid waste such as organic waste, to be eliminated naturally, most types of solid waste such as plastics are non-degradable so cannot be eliminated but can be re-used after appropriate processing through recycling. Plastic items sent to landfills take up to 1000 years to decompose, with plastic bottles taking 450 years and plastic rubber bags taking between 10-20 years (LeBlanc, 2019).

Recycling was defined by the Global Environment Centre Foundation (2006) as the process of re-using waste materials as raw materials in making the same product or another product. The Foundation stated that recycling reduces cost associated with landfills in addition to creating employment. However, developing countries do not consider plastic waste valuable and therefore do not give recycling the attention it

deserves. As a result of this, recycling industries in developing countries are generally young and informal (Troshinetz, 2005). `

Data from the Accra Plastic Waste Management Program indicated that 120 tonnes of plastic waste was recycled each day in Ghana in 2013 with 40% of this amount consisting of empty sachet water rubbers. More than 9,000 youth are engaged in the production of sachet water, collection of plastics and recycling business sectors. However, the functioning of these recycling firms are on a rather small scale. In comparison, the magnitude of the plastic waste generated is so large that efforts made to collect and recycle them do not seem to make a significant difference on the quantity of plastics littering the streets of Accra (Essel, 2015). To further understand the need for the management of municipal plastic waste, one of the Sustainable Development Goal (SDGs) will be evaluated in relation to waste management. Details about the SDGs are provided next.

1.3 Management of Plastic Waste and the Sustainable Development Goals

The Sustainable Development Goals (SDGs) generally referred to as Global Goals, were recognized by all member countries of the United Nations in 2015. This served as a universal charge to eradicate poverty, protect and promote peace and prosperity among humans by 2030 (United Nations Development Programme [UNDP], 2015).

The Global Goals total seventeen but for the objectives of this study, emphasis will be given to the twelfth goal titled: “Responsible Consumption and Production”. The goal states that to ensure environmental sustainability and by implication the survival of

mankind, is dependent on humans reducing their footprints ecologically by checking the way products are produced and consumed (UNDP, 2015).

The main aim of SDG 12 is to encourage businesses and industries to not only recycle waste, but also to reduce waste generation. Companies must reduce the production of carbon-polluting products, reuse what that they can, and recycle the waste generated from their use. Developing countries, are being pushed towards sustainable consumption by 2030. To achieve this for Ghana, there should be an increase in the capacity of recycling companies with the support of the government. With respect to the need for recycling, the problem statement is outlined in the subsequent section.

1.4 Problem Statement

According to the United States Embassy in Ghana (2019), the country has the potential to generate GHC 2 billion ($346,620,440) yearly and create 5 million jobs through the recycling of generated plastic waste. This was a main point stated at a multi-stakeholder Waste Resource Platform conference organized by the United Nations Development Programme (UNDP) in Accra in 2018. It was a conference that brought together stakeholders involved in the municipal waste management sector with the aim of creating a collaboration to deal with the menace of plastic waste in the country (Knott, 2018).

At the conference, the UNDP County Director Ms. Gita Welch stated that Ghana like many developing countries face significant challenges with managing the plastic waste of their urban cities. She further stated that the UN Sustainable Development Goal 12 (responsible consumption and production) cannot be achieved unless waste management and recovery opportunities are given priority. It is therefore imperative to

understand that issues surrounding plastic waste management should not be perceived merely as a sanitation or an environmental problem, but also an opportunity for job creation, economic development and technological innovation. According to her, Ghana needs a system to create synergies that are implementable and can generate revenue through the facilitation of new business models for recycling (Duho, 2018).

Focusing on Accra for the purpose of this research, the evidence of the challenges of managing municipal plastic waste abound: gutters are perpetually clogged with empty bottles, sachet water rubbers and plastic bags. A common complaint is that when people clean out their gutters the waste is piled next to the gutter, eventually finding its way back into the gutter. Rubbish piles can be found on street corners and are pecked at by birds. Especially after the rainy season, plastic bottles are found lining the beaches (Knotts, 2018).

Rubbish sprinkled with plastics are found in large waste containers located behind marketplaces in areas such as Tudu, Agbogloshie and Kaneshie, not forgetting large dumpsites located at Teshie, Ordorkor, Mallam and Oblogo. Others opt to burn their plastic waste by the side of the road and people who live close to major drainages or rivers often dump their waste in these drains and waterbodies. This has caused floods and as such stakeholders like the Accra Metropolitan Assembly, health workers and residents decided to employ the use of landfills (Boadi & Kuitunen, 2002).

Landfilling can be defined as a practice of burying large amounts of solid waste in a deep hole (Collins, 2009). The use of landfills at specific locations in Accra has come with not only serious health repercussions to the people who live close by, but to the government’s coffers in addressing their associated effect. Some residents living close by

have been affected by leukemia, eye irritations and respiratory diseases consequent to the stench of the landfills and its pollution of their water bodies. These effects were evident in the Kpone landfill site and thus, there was a call for its closure (Akordor, 2011).

As at 2015, World Health Organization (WHO) and United Nations International Children's Emergency Fund (UNICEF) had labelled Ghana as the 7th dirtiest country in the world and the 2nd dirtiest in West Africa. No measures have been taken by the country to improve this. As a result, poor sanitation has been costing Ghana's economy GHC420 million ($70 million) each year (World Bank, 2012). Much of this expenditure is spent on the annual pre-mature deaths of 19,000 Ghanaians which is mainly a consequence of poor sanitation. Additionally, about 7,500 children die yearly in Ghana because of dirty water caused by improper disposal of municipal solid waste which enters water bodies (Solomonov, 2015).

According to Oppong-Ansah (2018), about 2.58 million metric tons of raw plastic is annually imported to Ghana; of which 73 percent ends up as waste and less than 19 percent is re-used. A voluminous amount of plastic waste is generated yet only a small amount is recycled. Moreover, the amount of energy needed for using recycling materials are far less than making a completely new product. About 75% less energy is required when using recycled plastics to make a new product (Oppong-Ansah, 2018). Consequently, a huge disparity exists between the amount of plastic waste produced and the amount recycled in Accra. Recycling companies are currently operating on a small scale and the lack of pioneering by the government in this course has greatly reduced the wealth that can be created through recycling (Eshun, 2017).

To address this, the president of Ghana His Excellency Nana Akuffo-Addo stated that by the end of his four-year term of office (which ends: 2020), he intends to make Accra the cleanest city in Africa (Nyavor, 2017). He indicated that his administration hopes to solve this problem by implementing the internationally recognized waste management hierarchy which is reduction first, then re-use, recycle, recovery and lastly disposal. He stated that a vibrant recycling industry would help Ghana recover millions of plastic waste especially every year, and would provide an avenue for jobs to be created in the economy. He believes that through the establishment of recycling facilities, 20,000 direct jobs will be created through the setting up of associated holding centers in the capital of each region and collection centers in each district (Ibrahim, 2019).

According to Montana Department of Environmental Quality (2004), recycling boosts income growth, energy savings, waste reduction, job creation, lower cost of production for industries, conservation of natural resources and the extension of the life span of landfills. Therefore, it leads to the overall improvement in economic activities. This statement would serve as the basis for the null and alternate hypothesis below.

H0 - There is no relationship between recycling and increased wealth creation and the improved management of plastic waste.

H1 - There is a relationship between recycling and increased wealth creation and the improved management of plastic waste.

This study sought to test the validity of these hypotheses through the processes outlined in the methodology section (Chapter 3). Thus, it tested whether recycling is

indeed a strategy for increased wealth and improved plastic waste management or whether other factors such as adequate capital and improved infrastructure play a role.

In summary, this study sought to discuss the problems encountered in plastic waste management in Accra and to explore the associated revenue that the city could gain through recycling. A beautiful, clean city where waste is effectively managed creates a healthy and attractive environment for tourists, residents and business investors.

1.5 Research Questions

This research sought to answer the following research questions.

- What is the present state of recycling in the city Accra? Encapsulating their suppliers, the resources available to them, the type of waste they recycle and their operational process.
- What are some of the problems encountered by recycling firms that may be a hindrance to the expansion of this industry?
- Can recycling effectively generate wealth through Accra's municipal plastic waste?

1.6 Objectives of Research

The main aim of this study was to examine the strategic role that recycling plays in promoting plastic waste management for wealth generation in the Accra Metropolitan Area. Below are sub objectives of the paper.

» To determine to what extent plastic waste is currently recycled in Accra and the associated challenges facing recycling as a solid waste management strategy.

» To examine the strategic role recycling can play in promoting plastic waste management, employment and wealth creation in the city of Accra.

» To recommend strategies for cost-effective recycling and associated employment creation given the challenges.

1.7 Significance of the study

This study will provide information that will inform stakeholders in the public sector waste management such as Zoomlion Company Limited, Ministry of Environment and the Metropolitan Municipal and District Assemblies (MMDAs) that recycling is a pragmatic problem-solving approach. It will also be of great importance to the government as it provides an exposure on the benefits derived from recycling and the potential revenue of a thriving large-scale recycling industry.

According to the Deputy Minister of Health in Ghana, Dr. Victor Bampoe, Ghana loses $735 million annually due to the spread of malaria. This expenditure can be reduced through improved sanitation and a cleaner environment (Essabra – Mensah, 2015). Therefore, it is necessary for the government to support institutions already undertaking recycling as they are integral in improving sanitation in Accra. The practical approaches to managing municipal plastic waste through recycling that are identified in this study can be embraced by the government, businessmen and women (firms) and economists to provide an avenue for the employment of the populous residents in Accra.

This study will also contribute to an existing body of knowledge on solid waste management and will be an academic source of information for researchers and students who will undertake studies on this subject in the future.

Furthermore, the findings of this research highlight the importance of integrating solid waste management into school syllabuses by the Ghana Education Service (GES).

Moreover, when the World Health Organization (2003) required the government of African countries to prioritize the general health of their environment, it was realized that the waste generated from solids mainly plastics was the second problem prevalent in these countries proceeding the problem of poor water quality (Zerbock, 2003). Therefore, MMDAs and the National Commission for Civic Education (NCCE) must deem it necessary to educate citizens against certain practices and attitudes that lead to the indiscriminate disposal of plastic waste.

1.8 Organization of the Study

This thesis has been organized into five chapters. This chapter, being the introductory chapter consists of the background, problem statement, research questions, objectives and significance of the study. Following this chapter is chapter two, which contains the literature review. In the literature review, relevant existing literature, existing theories and conceptual frameworks on solid waste management are examined. The third chapter describes the methodological approaches the study used, detailing the steps involved in achieving the objectives of the thesis. It justifies the research design, target population, sample size determination, data collection and analysis of methods as well as the data sources. It further includes any shortcomings associated with the research instruments and the gathering of data. The fourth chapter presents the results or findings and analysis. The final chapter provides a summary of the main findings, conclusion and recommendations.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter examines literature on municipal plastic waste management and recycling's role in achieving this. The chapter has been organized into three major sections. The first section introduces existing theories on this subject. The second explores concepts, methods and the problems created by improper disposal of municipal plastic waste and the role of recycling in revenue generation. The last section concludes this chapter with a summary of various lessons drawn from the review of the various literature and discusses similar studies to justify the relevance of this study and the gap it sought to fill.

2.2 Conceptual Framework

To understand the present state of recycling in Accra, a conceptual framework derived from Integrated Solid Waste Management (ISWM) was used. The main segments in the conceptual framework for this study are the collection of plastic waste, the availability of recycling companies, the revenue from recycling, and the needed government support to establish such a system that provides an opportunity for recycling to thrive in Accra. The relevant stakeholders in this framework are municipal authorities, management of recycling companies, waste collection services, environmental regulators, households, firms and politicians.

2.3 Integrated Sustainable Waste Management Framework (ISWM)

The ISWM is a framework that helps to assess all processes of solid waste management from its prevention through to its disposal. It examines the environmental, financial, technical, social and institutional areas of the system of managing waste

(UNEP, 2005). It employs a more holistic approach to; decrease pollution related to mining and consumption of resources and the disposal of solid waste (Masters & Ela, 2008).

The elements considered in relation to ISWM are waste prevention, waste reduction/minimization, re-use of products, recovery, recycling, composting for manure production, incineration with and without energy recovery and disposal in landfills. These are listed in order of priority (Durham County Council, 2007). These elements have been generated into a waste management hierarchy model. This hierarchy is defined as a "penny-plain piece of common sense that places the various strategies for waste management in order of environmental friendliness, from best to worst" (Girling, 2005). The individual components are further discussed below.

Waste Prevention and Source Reduction: The aim of waste prevention and source reduction is to prevent the generation of waste. Strategies to achieve this include reducing packaging, increasing the life span of products in their design and reusing products and materials. Waste prevention seeks to reduce the cost associated with handling and treatment, through to disposal. It also decreases pollution, such as water and atmospheric pollution, that would be caused in the treatment process (Masters & Ela, 2008).

Recycling and Composting: Recycling is the collection and recovery of certain solid waste especially plastics and organics that act as raw materials in making another product or the same product. Some of the organic materials that are recycled are rich in nutrients and help enrich the soils. The transformation of these waste into soil additives is known as composting. (Zerbock, 2003).

Disposal (Land filling and Combustion): These methods manage waste that cannot be prevented and are unrecyclable. One way to dispose waste is to safely construct and manage landfills. Another way is combustion which is the regulated burning of waste to decrease its volume. With the available technology and good landfills, energy can be obtained through recovering methane. The steam produced from combustion is also a by-product from the production of energy (Garthe & Kowal, 2006).

In summary, the ISWM is a framework that helps to assess waste prevention through to its disposal. This study highlights recycling and explores the role it plays in the management of municipal plastic waste as well its potential economic benefits. The next section will explain the concepts in plastic waste management.

2.4 Plastic Waste, Types and Sources

The American Chemistry Council (2015) defines plastics as materials that are obtained from various elements such as chlorine, sulfur, oxygen, nitrogen, carbon and hydrogen. Plastics are man-made organic materials produced from raw materials of oil and natural gas with molecular weights that can range from 20,000 to 100,000 mg/L.

Plastics are generally divided into two parts based on their processing, either thermoplastics or thermosets. Thermoplastics are materials that soften easily when heated and hardens when cooled. They can also be melted down and transformed into a new plastic product. Due to the way they can be easily molded into different shapes, they are usually employed in food packaging (Ampofo, 2015). Thermosets do not undergo repeated heat treatments due to their complex molecular structure; as a result of this, they are not reprocessed into new products. They are durable in nature and are used in

automobiles, construction and in applications such as adhesives and coatings (Ampofo, 2015).

The four types of plastics that are currently used and recycled in developing countries are polyethylene (PE), polypropylene (PP), polystyrene (PS) and polyvinyl chloride (PVC) (BBC, 2014). Polyethylene becomes hard and stiff when sterilized, it is therefore used as shrink wraps for products, and it is also used to make bottles. As compared with PE, polypropylene is more rigid and can bend sharply without breaking. It is used for food containers, chairs, ropes, pipes and crates. Polystyrene is brittle and mostly transparent in its unprocessed form, because of this, it can be used for light fittings and cheap transparent kitchen ware. Polyvinyl chloride is usually stiff, strong and scratch resistance and it is used in pipes and window frames (BBC, 2014). To recycle plastic waste, management of it must be effective.

2.5 Plastic waste management

Plastic waste management is the process whereby plastic waste is collected, treated, stored and transported (LeBlanc, 2018). According to World Population Review (2019), in 1999 the population of Ghana was 18.48 million, 20 years later the population has grown to 30.42 million with a current annual growth rate of 2.2%. Ghana Statistical Service (2019) indicated that migration within the country grew at the rate of 9.7% yearly between 2000 and 2010. The rapid increase in population and urbanization results in a rise in waste generation, making its management imperative.

According to Boadi and Kuitunen (2004), some factors affecting poor plastic waste management in Accra include weak institutional capacity, lack of capital, rapidly growing urban population, poor planning of waste management activities, apathetic

behavior of the public to the environment, lack of skills and capacity of recycling firms and inadequate infrastructure and sites for waste management activities.

The above challenges listed buttress Troshinetz's (2005) results from the study that was conducted on twenty-three developing countries to identify factors that influence sustainable recycling of municipal solid waste in developing countries. The summary of the research was that the three major hurdles to achieving sustainable recycling of plastic waste in municipalities are: lack of available waste collection and segregation services, lack of education of the public on municipal solid waste management and inadequate budget allocation by the government to manage solid waste.

2.5.1 The Issue of Plastic Waste Management

In Accra, a major problem resulting from improper disposal of plastic waste is soil contamination. Most plastic waste eventually ends up in landfills where hazardous chemicals are excreted into the soil. Diethyl hydroxylamine (DEHA) is released from plastics when they break down and this affects the reproductive system and leads to weight loss and liver dysfunction. It also affects plant growth which then affects the humans and animals that feed on it. Animals who feed on grass in landfill areas that are contaminated are prone to poisoning from the toxins contained in the soil. Poor sanitation also badly affects the economy of a country. Residents want to stay in a healthy and clean environment and providing the opposite will assuredly not bring in tourists nor investors, thus, reducing productivity (Owusu-Banahene, 2019).

Per the World Bank's report (2016) titled "What a waste 2.0?", the world generates about 242 million tonnes of plastic waste annually with more than 33% of this waste not managed ecologically. An update of this report in 2018 projects that population

growth, economic development and urbanization will increase global waste by 70% in the next 30 years leading to an annual output of 411 million tonnes of plastic waste. Due to the expected rise of waste generation with economic development, lower middle-income countries are expected to experience the most growth in waste production. The regions with the fastest growth include Sub-Saharan Africa and South Asia where the sum of plastic waste is expected to triple by 2050, thereby, consisting of 35% of plastic waste globally. High and upper middle-income countries provide an almost universal collection of plastic waste and more than one third of it, is recycled. However, low income nations collect 48% of city plastic waste and only 5% of it is recycled (World Bank, 2018).

Proper management of waste is worth the cost. It is indeed vital to invest in sustainable management of plastic waste because uncollected or poorly disposed plastic waste is dangerous to the environment and the health of its inhabitants. The cost of addressing this impact is much higher than the cost of developing and running a simple but efficient and adequate plastic waste management system that can generate revenue (World Bank, 2018). In effect, possessing a good waste management system is a good investment and is more cost effective in the long term. Recycling is key to achieving this.

2.6 Recycling of Plastic Waste

Recycling is the process of turning materials that would otherwise be considered as waste into valuable resources, leading to environmental, social and financial gains in the conservation of natural resources, energy conservation, pollution prevention and economic growth (US EPA, 1999). Recycling is essential in reducing the amount of municipal plastic waste that are sent to landfills and dumpsites. It also supplies much needed raw materials to industries (Momoh and Oladebeye, 2010).

Kreith (1994) further stated that recycling should be the preferred plastic waste management strategy considering its practicality in comparison to the other options. He suggests that through recycling, raw materials can be brought to the market through the retrieving of reusable plastic materials from municipal solid waste. He is of the firm belief that the advantages of recycling cannot be overemphasized. It reduces the need to mine new materials which lessens the associated environmental effect of mining and processing. This also saves resources. To summarize, Hoornweg and Bhada – Tata (2012) view recycling as a reverse distribution that occurs through a backward procedure in which packaging that can be re-used and other solid waste are returned to the producer.

In cities of developing countries, recycling is usually carried out informally. Plastic recycling is particularly carried out in local markets that are normally poorly regulated. Nevertheless, advanced technology and highly designed systems of operations are still required later in the recycling process (Hoornweg & Bhada - Tata, 2012).

2.6.1 Scavenging Activities

According to Scheinberg and Anshütz (2007), waste collection in the informal sector is done through an activity called scavenging, which is the search and collection of usable materials from waste. Scavengers are instrumental players in the informal economy of plastic waste management as their contributions are essential both environmentally and economically to their cities. However, their jobs are fraught with certain hardships namely exploitation by middlemen, stigmatization and dangerous working conditions (Scheinberg & Anschütz, 2007).

In Accra, recycling is not a primary waste management activity. Nonetheless, the retrieval of materials via scavenging is a daily phenomenon for small scale enterprises and waste pickers (scavengers) rendered desperate by poverty. Scavenging occurs at both legal and illegal dumpsites, and in the streets of neighborhoods. These scavengers search for valuable plastics that are considered reusable and can be sold to sellers (Wilson & Cheeseman, 2006).

Scavengers also negotiate with households and firms for buying of the plastics that they deem valuable from households and firms. The plastics obtained are taken to the scrap markets that are run by middlemen. These middlemen can be considered as waste traders. At the scrap market shops, the plastic is sorted, weighed and purchased from the waste pickers. These waste traders then transport the raw materials to be utilized by various recycling industries (Adebola, 2006). In developing countries such as: Ghana and Nigeria, scavengers rely on recycling for income. This work promotes a positive social externality as there is reduction in the production cost in certain sectors and lengthens the life span of landfills. Scavenging is therefore important to the recycling process in developing countries (Adebola, 2006).

Gonzales (2003) opines that it is necessary to create policies to promote the role of scavengers in developing countries by improving production efficiency, consumption and waste disposal. Hogland and Marques (2000), are also of the view that the survival of waste pickers depend on certain factors such as: the availability of market for recycling materials; the quantity and quality of plastic waste generated and how well scavengers are paid. Comparing these opinions, although Hogland and Marques' (2000) view is valid,

there must be regulations and policies concerning municipal plastic waste as stated earlier.

Regarding the economics of scavengers, there is a direct correlation between consumption and waste. Escalated consumption has resulted in an equivalent increase in waste (de Coverly, 2008). Medina (2000) asserts that a greater part of the world's growing informal economic sector comprises of waste picking. Over 15 million people worldwide make ends meet by recovering and recycling municipal plastic waste.

Unfortunately, city authorities in developing countries do not recognize the key role scavengers play in recycling municipal plastic waste (Medina, 2000). It is evident that these traditional systems of recycling ought to be properly developed. A formalized system of recycling coupled with support from the local municipality can help to protect the safety of recycle workers and aid scavengers and small-scale merchants in obtaining a better income (Zerbock, 2003).

2.7 Theoretical framework for recycling of municipal plastic waste

Quartey, Tosefa, Danquah, and Obrsalova (2015) designed a theoretical framework for the municipal recycling of sachet waste that can be adopted by African countries to recover plastic waste. The purpose of this framework is to establish an approach that is community based to manage the plastic waste generated in municipalities through the sharing of responsibilities among, households, producers and municipal authorities. By encouraging the participation of households and producers, and entrusting them with responsibility, a greater portion of plastic waste which usually ends up at dumpsites would be recycled efficiently at minimum cost. This strategy seeks to create a

formal multi-stakeholder return and/or buy back system that will aid in the collection and return of plastic waste for recycling and is in line with the ISWM framework (Tsiboe & Ernest, 2004). Below are the collection methods under this framework which, where applicable, can be adopted by municipalities.

2.7.1 Bring system

In this system, discarded plastics are required to be brought by the consumer to a collection container or something similar, placed at a reasonable distance from the consumer's residence. This is achieved by planting recycling stations and drop off centers amongst others (Myers, 2000). In Sweden, the packaging of waste that is practiced is an example of this system that is dependent on the delivery of discarded plastics by customers to containers placed at vantage points within a city. The is a cost-effective collection of plastic waste (Eurostat, 2011).

2.7.2 Kerbside Collection System

In this system, discarded plastics are collected near the location of consumers, similar to the manner in which ordinary household wastes are collected. The large-scale kerbside collection system is the German and Japanese packaging collection model with the potential of high collection rates being achieved (Mark, 2010).

Japan and Germany are renowned for their well-functioning waste collection systems. In these countries, recycling is practiced at grassroot level. Households and institutions carefully separate their own waste materials to expedite the recycling of plastics. For Japan in particular, their law on container and packaging ensures that the waste of households in the country such bottles, paper, glass, cardboards and biowaste are separated in their collection using different colored bags (Gugssa, 2012).

In the European Union (EU), Germany has the highest rate of recycling with 48% of their waste been recovered. Germany's growth in waste management is largely due to its strict waste management legislations and governance system (Eurostat, 2011). Germany like Japan, color codes the various types of solid waste. Multiple waste bins are available at collection points (Gugssa, 2012). In both countries (Japan and Germany), community indulgence and unity are fostered when the checking of sorted waste materials and the pressing of bottles are done together by members of the community before they are picked up (Gugssa, 2012). Below is a recycling scenario under this theoretical framework that can be adopted.

Solid waste recovery by producers and recycling companies

The recovery of waste by producers refers to manufacturing enterprises of plastic waste and retailers of these products, establishing their own source of recovery and partnering with recycling companies by assuming the financial and physical responsibilities for the management of their products to the end of their life span. This method can be adopted by both small and large-scale producers of products contained in bottles, cups and sachets among others (Wantanabe, 2003). Reverse logistics can be implemented for these products to be recovered and reused. Recycling companies in partnership with producers can recover waste from consumers through incentives such as discount coupons.

Should this process of recycling be undertaken in Accra, it will provide an opportunity for producer responsibility to be extended as required by SDG 12. These producers can recover the plastic waste from consumers and retailers. The collection and transportation cost can be recovered using the same distribution trucks to return them

after distribution instead of returning with an emptied vehicle. They can then go on to sell them to the recycling firms. This can reduce cost and waste allotted to landfills. Alternatively, a partnership between organized informal waste pickers and informal operators may produce the same result. This would enable them to recover plastic waste generated before they are burnt or taken to landfills and dumpsites.

To effectively implement the above, public participation is crucial. The participation of stakeholders as explained in the ISWM framework is necessary for decision-making, mobilizing resources, planning, coordinating and executing a good waste management system (Otu, 2011). To cure the apathetic behavior of Ghanaians, the state can implement a recovery program in Accra, creating an awareness of recycling (Owusu-Sekyere, 2013).

Awareness should thus be created through formal and informal education with the aid of electronic and print media. Through education, people may learn that recycling is one of the surest ways to protect the environment. It also grows a sense of responsibility among the various communities in a municipality (Owusu-Sekyere, 2013). The creation of a stakeholder participation forum is necessary to motivate the public to participate in sound environmental practices. This may include publicizing the environmental impact of littering and indiscriminate dumping on radio and TV shows every week. Bi-weekly articles on methods to effectively recycle waste should be published. Public meetings should be held to sensitize people in all classes on the pros of recycling (Clifton, 2014).

2.8 Economic Benefits of recycling

The economic benefits of recycling have been emphasized from the beginning of this study. Its role in reducing the cost associated with landfills, air and water pollution

and associated expense to the government of Ghana has been examined. Its significance in reducing the need to mine (virgin) natural resources such as minerals was also stated. Furthermore, job opportunities are created especially in the manufacturing and recycling industries when recycling is patronized.

An example of the economic benefit of recycling is that several informal waste collectors in Accra are not provided with standard labor contracts. However, once a waste picker collects more than 1000 kg in a year, their health insurance is covered for the next year. This helps to bring these individuals closer to the formal sector and also secures the consistent supply of raw materials. A scavenger makes a minimum of 16-20 cedis daily. This may not be considered as much but it is about twice Ghana's minimum wage of 9.50 cedis. However, there are a few outliers of people making 30-40 cedis a day. (Meinel, 2018).

According to the Ghanaian Times (2016), middlemen (major collectors) are the bridges between waste pickers and recycling companies. Middlemen buy plastics at half the price from individual scavengers and in turn sell to recycling companies. The balance remaining after the deduction of transportation and labor cost is the profit. Many current major collectors began as minor collectors. Some of these middlemen own between three to four trucks used to transport the plastic waste obtained to the recycling companies. These middlemen receive a turnover between GHC 2,000 – GHC 6,000 ($333 - $1,000) a month. This is a clear indication that plastic recycling is a good source of income (Amengor, 2016).

Plastic recycling activities are economically profitable and play a significant role in improving the standard of living of some residents in Accra. The high demand for the

labor needed for the waste picking and sorting processes provides jobs for many. The income earned furthers the economy. Through plastic recycling, Accra also stands to benefit from the minimization of waste and reduced expenditure on solid waste management. It can be concluded that owing to the great benefits that the recycling of plastic waste introduces, formal rules and policies should be implemented to fully integrate it as a main plastic waste management option (Owusu-Sekyere et al., 2013).

2.9 Lessons Learnt

As discussed in the literature review, the management of plastic waste in developing countries does not only provide environmental benefits but economic opportunities as well especially for the poor in the society.

Considering the AMA's, lack of funds, and the apathetic behavior of most Ghanaians regarding waste management culture, the adoption of a multi-stakeholder approach is required to manage this problem. Policy approaches such as: product stewardship and extended producer responsibilities can be implemented to aid municipal authorities in sharing the responsibility in the management of plastic waste.

A community-based approach can also be considered where households, producers and city authorities are tasked to manage the plastic waste generated. The participation of these stakeholders would vastly reduce the solid waste that would be available for disposal. The success of recycling does not only rely on the rate of participation, efficiency of available equipment and infrastructure: it also depends on the quality of the waste recovered. It is therefore necessary to collect these recyclable

materials at the early stages to prevent them from getting mixed up with other materials or ending up in landfills.

It is imperative that municipal authorities develop a system of management which integrates the operations of the informal sector and aids in improving their current condition. Subsequently, creating a more positive and public outlook towards waste pickers through the campaign of civil societies is necessary.

Moreover, the formulation of national policies and regulations concerning the collection and sorting of plastic waste is needed. Municipal authorities can assist by eliminating impediments to entrepreneurial activities of operators in the informal and formal sector. This is important to the sustainability of the management of waste. Municipal Authorities should be encouraged to engage in developing research that focuses on recycling technologies (i.e., pre-treatment stage) and new forms of recycling.

2.10 Gap in Literature

As mentioned in the beginning of the chapter, Troschinetz (2005) studied factors that influence sustainable recycling of municipal solid waste in twenty-three developing countries. However, Ghana was not selected for study. Although there are a few peer reviewed journals that explore the framework of the AMA in enforcing general municipal solid waste management, they are limited to the environmental benefit of recycling and not its economic potential. This study sought to bridge this gap by exploring recycling plastic waste in Accra Metropolitan Area (AMA) as an avenue for revenue creation.

A study on the Kumasi Metropolitan Area of the Ashanti region revealed that there is economic potential in the collecting and recycling of plastic waste. This study

was conducted by visiting suburbs and public areas that were selected through both purposive and random sampling. It was then concluded that recycling is a profitable venture that individuals can rely on for their livelihood. However, to effectively mobilize this industry, legislations must be passed that should not only be implementable but also enforceable (Owusu – Sekyere, Osumanu & Abdul – Kadri, 2013). Considering this study on the economic potential of recycling, this thesis seeks to provide such information tailored to the Accra Metropolitan Area.

This research highlights the benefits of recycling and investigates its effect on the SDG 12. This goal purports that by 2030, responsible consumption and production should be attained by countries through the reduction of their ecological footprint. To aid in this process, this thesis sought to provide a blueprint on how this can be made possible in Ghana, specifically Accra.

CHAPTER 3: METHODOLOGY

3.1 Objective of Research

This study sought to explore the strategic role recycling plays in reducing municipal plastic waste as well as the revenue that can be generated from undertaking plastic recycling. This chapter outlines how the research was conducted. It begins with the scope of the study, describes the type of research design adopted and the target population. It also discusses the sources of data, sampling procedures, data collection and analysis, ethical concerns and the reliability and validity of the study.

3.2 Scope of Study

The target population for the research was the 15 plastic recycling firms in Accra. Due to cost considerations and for feasibility of data collection, the study area was limited to the Accra Metropolitan Area. This research considered three recycling companies: Accra Compost and Recycling Plant (ACARP), Integrated Recycling and Compost Plant (IRECOP) and Jekora Ventures. These companies were selected because they have a large capital base, employ many people and are located in the main business district of Accra. Their ages range from two to seventeen years. Below is a brief profile of these companies.

Zoomlion Ghana Limited is a giant in the environmental sanitation and waste management industry in Ghana. The company has 3,000 employees and through public private partnerships manages over 85,000 workers (Zoomlion Ghana, 2020).

ACARP a subsidiary of the Zoomlion group of companies was established through a private public partnership with the government of Ghana mainly to produce

organic compost. ACARP recycles plastics and produces high quality pelletized plastics for use by the local industries for further production (Zoomlion Ghana, 2020).

IRECOP is a major private sector intervention to the challenges encountered in waste disposal in Ghana. Their current plant has the capacity to process and recover 800 tonnes of waste on a 16 hour shift a day drastically helping to reduce the waste that goes to landfills. IRECOP provides 78 direct jobs and 1,400 indirect jobs (IRECOP, 2019).

Jekora Ventures is a waste recycling service established in 2003. They offer waste pick up services on a residential and industrial level. It is a smaller company whose services are limited to Ghana (Jekora Ventures, 2019).

Accra Compost and Recycling Plant (ACARP) and Integrated Recycling and Compost Plant (IRECOP) are among the market leaders in the recycling industry and are all subsidiaries of the Jospong Group of Companies. Due to lack of information and the poor structure of this industry, the market share of these companies cannot be easily determined. Nonetheless, these two companies are the recognized leaders in this industry particularly with regards to their size, capabilities and revenue (Awuni, 2019). For a deeper understanding of the operations of the recycling industry, two waste management companies and the Accra Metropolitan Assembly office were included in the study.

3.3 Research Design

Research design is a detailed plan made by a researcher that directs the way a research is executed. It comprises the location and time of the research, the sample size, sampling procedure, data collection and data analysis (Sarantakos, 2000). This study uses qualitative research which is tailored to describing the individual experiences and beliefs

of the target population. It allows for in-depth questioning and deeper probing of the responses of respondents where the researcher tries to understand their feelings and motivations and how they take decisions (Bhat, 2018). Some of the types of qualitative research include focus groups, case study and interviews (in-depth and semi-structured).

For this study, only semi-structured interviews were considered. This type of qualitative research provides a great opportunity for a researcher to gather precise data about the beliefs of respondents. Semi-structured interviews are meetings that provides an opportunity for follow up questions to be asked and as such, is insightful and key in providing relevant information. (Bhat, 2018). A major strength of semi-structured interviews is that although the same questions are asked to all respondents for comparison, a part of the interview allows for different questions to be asked to enable respondents freely provide information (Bhat, 2018).

3.4 Sources of Data

Primary and secondary data were employed in this study. Primary data was collected from three recycling companies (Jekora Ventures, ACARP and IRECOP), two waste management companies (Alliance Waste Limited and Zoomlion Company Limited) and the Accra Metropolitan Assembly office. Secondary data such as journals and websites were used to obtain information about the companies and plastic recycling in Ghana (such as the company profiles, the services they render, employee strengths, achievements, and statistics about plastic waste in Accra among others). These data sources were chosen for the study because they contain relevant data in a credible and accurate form to help gain deeper insights into the operations of the recycling industry and how solid waste is managed to bring out the maximum potential of these companies.

3.5 Sampling Strategy

A non-probability sampling strategy was used to select these companies. Due to time and financial constraint, the companies were selected as respondents based on their availability and location within the AMA. In each of the three companies, the specific stakeholders interviewed were the finance and operations managers because they have intimate knowledge of the operations of the companies. A similar sampling strategy was employed by Samuel Donkoh and Felix Puopiel in 2016 and 2010 respectively in a bid to assess the importance of managing solid waste for the improvement of the environment in Accra and Tamale. This strategy proved advantageous in helping them accomplish their goal and thus, a similar one was employed in this study.

3.6 Data Collection Tools

Data was collected in the months of February and March which were the timeframe and deadlines associated with this study. To achieve the objectives of this research, an interview guide was prepared and used to collect data. Care was taken to ensure that the questions enabled the research objectives to be achieved. The use of interviews made it possible for respondents to air their views without restriction and allowed spontaneous but accurate responses to emerge. For participants who were unable to be interviewed face-to-face, open ended questionnaires were used to obtain data.

3.7 Research Procedures

In order to collect data, trips were made to two of these three companies. Prior to visiting the companies, permission was obtained from Ashesi's Institutional Review Board (IRB). The Business Department at Ashesi also provided the researcher with a formal letter of introduction for each of the institutions to be delivered to the Human

Resource Manager. The letter specified a request to collect data. The researcher was familiar with the Group Financial Controller for the Environmental and Sanitation Group of the Jospong Group of Companies which is the parent company of Zoomlion Ghana Limited, ACARP and IRECOP.

Consequently, using the snowballing approach the researcher contacted the remaining three companies easily and even got access to the Accra Metropolitan Assembly Office. To introduce the study to them, phone calls were made to agree on the possible dates to visit the site and to conduct the interviews. Once they all consented, an appointment was made for the researcher to come and collect all the relevant information.

The respondents constituting the sample in the selected companies comprised of senior and intermediate staff not junior staff. Accordingly, the finance and operations managers of the various companies were the people interviewed. To ensure privacy and confidentiality, during the interviews which lasted between 30 minutes – 1 hour, no recordings were made but then handwritten notes were taken and typed later. However, due to the busy schedule of three of the interviewees, the session had to be conducted over phone. A point to note was that the consent form carried along was only requested by one company whilst the other five did not find it necessary and gladly provided the needed information. The next segment presents the method used in analyzing the data.

3.8 Data processing and analysis

The responses from the interviews were collected and summarized using thematic analysis to either support or object the key findings. The use of a thematic design helped to identify and give ascendency to the relevant variables in the research questions that are significant for the study. After all the data was collected and typed, it was read over to

ensure that it sought to articulate the points raised with regards to understanding the way plastic waste is managed in Accra, the operation of the recycling industry and its wealth benefits. In the process of analyzing, the need for more data was identified, and some confirmations were needed. So, phone calls were made to the relevant respondents. Through the understanding gained, the data was summarized and analyzed using themes.

3.9 Ethical concerns

The generally accepted code of ethics was strictly complied with and there was no engagement in pretense. The privacy of respondents was respected in cases where they did not want to answer some questions. The confidentiality of responses and the anonymity of respondents were stringently ensured, and the data gathered was used exclusively for the purpose of this research.

3.10 Reliability and Validity

Considering the fact that this research used the qualitative approach, the processes undertaken are outlined in detail to ensure that future researches can be undertaken with similar results being obtained. Nonetheless, it must be noted that should changes happen in the industry of recycling, variations may arise in the results of the studies that may be carried out in the future if the researchers adopt a similar methodology. The interview guide that was administered was cross checked for completeness and accuracy. This was to ensure that the questions that were asked actually measured what they were meant to measure and were not subjected to changes by the participants. This ensured the objectivity, accuracy, precision and consistency of the research. The results obtained after this methodology was implemented are analyzed in the next chapter.

CHAPTER 4: RESULTS

4.1 Introduction

This chapter seeks to present and analyze the results. Therefore, this chapter is segmented into two sections, the first section presents the findings and then the second section discusses the findings. These findings are further grouped into three categories: the present condition of recycling of plastic waste in the Accra Metropolitan Area, the challenges experienced by recycling companies and the associated wealth of recycling plastic waste.

4.2 Existing Condition of the Recycling Industry

In this segment, the current condition of three recycling companies in Accra will be analyzed through their sources of obtaining plastic waste, the different types of plastic waste they recycle and the steps they undergo to provide recycled products.

Data gathered from the participants proved that despite the fact that the introduction of recycling companies to Ghana is over twenty-seven years old, the growth of the industry is heavily stunted. Most recycling companies in Ghana are in their infant stages. The Ghanaian recycling industry is not a competitive market as there are only few firms operating: it is essentially an oligopoly. This stems from the fact that setting up a recycling company is a capital-intensive process. According to Keesman (2019) there are currently a little over 25 well established recycling companies in Ghana.

The passiveness the Ghanaian society demonstrates towards the industry has left it unstructured and unregulated. This reality confirms Troschinetz's (2005) argument that developing countries do not value plastic waste to the degree they ought to, and

consequently neglect to proselytize recycling and develop the industry causing the recycling industry in these countries to grow at a slow pace.

To combat this, the Ghana Recycling Initiative by Private Enterprises (GRIPE) was established in 2017. This is a coalition of eight multinational companies who are relevant stakeholders in the plastic sector. The aim of the initiative is to integrate sustainable waste management solutions particularly around plastics. Their accomplishments so far are public awareness and education, placing waste containers in Tema and Accra, setting up sorting and processing centers for plastic waste, engaging 3,800 school children in 19 schools to participate in recycling, employing 360 waste pickers and establishing over 60 waste collection points (Wubonto, 2019). Although this initiative has been adopted by some plastic producers, recycling companies have no exclusive association for themselves.

According to the UNDP (2019), Ghana generates 1 million tonnes of plastic yearly and only 2-5% (22,000 – 55,000) is recycled and the rest are distributed as follows: landfill (38%), land (28%), sea (23%) and burned (11%). This information is illustrated in the figure below.

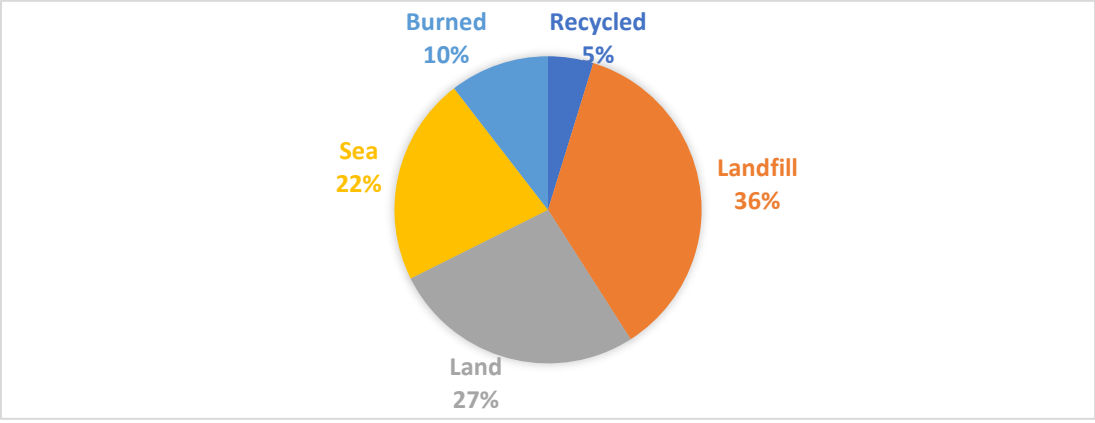

Figure 1. Distribution of plastic waste generated in Ghana.

As can be seen above, Ghana recycles a minuscule amount of the plastic waste it generates. The above illustration proves that recycling is the least used method of solid disposal in Ghana attesting to how the country is still relying on archaic methods to manage plastic waste. Hence, although Ghana currently has over 25 recycling companies, more effort should be put into increasing recycling. After understanding the current state of the industry, the sources of plastic waste will be analyzed.

4.2.1 Sources of Plastic Waste

Consistent with findings in the literature review, all three respondents cited residences, businesses and industries as sources of plastic waste. Residences are currently the lead generator of plastic waste. As a result, some recycling companies offer residential pick up services. Only one out of the three recycling companies consulted provide this service along with industrial pick up services because it offers both waste management and recycling services. The other two companies consulted however obtain waste from waste management companies who are their suppliers and concentrate their scope of operations to recycling the waste.

According to the one company, pick up services involve door to door, curbside and communal dumpsites pick up. The door to door and curbside methods of collection are usually conducted in middle and upper-class residential areas. The beneficiaries of door to door collection pay a 30-day fee of between 15 - 100 cedis per 120-liter dustbin for a weekly pick-up. The communal option is the popular choice of those living in low class residential areas and at marketplaces. Waste is put in containers called skips and are collected once a week or as and when they are full, with the cost usually borne by the government. Below are the types of waste recycled from these sources.

4.2.2 Types of Plastic Waste Recycled

The consulted companies offer a variety of recycling solutions, some unique to each company. Scrap waste recycling, paper waste recycling, e-waste recycling, textile waste recycling, organic waste recycling and plastic waste recycling are the recycling solutions offered by the three companies. Plastic waste recycling is the common denominator amongst the companies and is the focus of this study.

It was discovered, through the semi-structured interviews conducted that soft plastics such as empty sachet water rubbers and PET (polyethylene terephthalate) bottles comprise the majority of plastic waste recycled in Accra. These plastics possess low density polyethylene (LDPE) and high-density polyethylene (HDPE). PET bottles are especially valued and are in high demand because they are easy to recycle and can be traded for a profit. In retrospect, the four types of plastics commonly recycled in developing countries are polyethylene (PE), polypropylene (PP), polystyrene (PS) and polyvinyl chloride (PVC) (BBC, 2014). The interviews proved that all but PVC and PS are recycled by these companies. This, they stated, was due to the current technology they possess. An opportunity for job creation can be grasped from this gap as these plastics (PVC and PS) are found in car parts and pipes and are produced in Accra.

The Ellen McArthur Foundation (2019) stated the use of plastic packaging is essential to everyday life. Plastic packaging increases resource productivity. It lengthens the shelf life of products and can reduce the weight of packaging thus, reducing fuel consumption for transportation. As explained by the participants, in the Ghanaian context, it is estimated that approximately 80% of citizens can access potable water because of the simple innovation developed locally called "pure or sachet water". In times past, many

people suffered from a lot of water-borne diseases such as typhoid fever, cholera and dysentery because they drank unclean water. But now, as evident in figure 2 below, cheap treated drinking water is sold in plastic pouches or "sachets" which are affordable to the masses. It is this plastic sachet that the locals term as "sachet water rubber".

Figure 2. A picture of sachets of water sold in Accra.
Source: (Author, 2020)

This product shown above is often disposed of immediately after the water is consumed and is usually left where the water was drank or in proximity to it: on the road, in vehicles especially public transport vehicles, on farm lands, in streams, in front of buildings, out in the open, in gutters among others. One sachet water costs about 10 pesewas (1.7 cents) on the lower end and 20 pesewas (3 cents) on the high end.

The low cost of the sachet water is the main reason sachet water rubbers are such serious plastic waste polluters. A high percentage of plastic waste in Ghana constitutes sachet water rubbers (Addei, 2016). A kilo of these sachet water rubbers is sold at 1 cedi

to recycling companies. After these types of plastics are obtained from varied sources, they go through the recycling process elaborated below.

4.2.3 Process of Recycling

It was discovered during the interviews that the recycling process can be broken down into six distinct stages. These stages are standard but may differ a bit as some processes may be combined or omitted based on the state of the raw materials received and a change in the goal of the end product. The three plastic recycling companies undergo the following six-stage recycling process (collecting, sorting, washing, agglomeration, pelletizing, and sale and delivery) evident in figure 3 below.

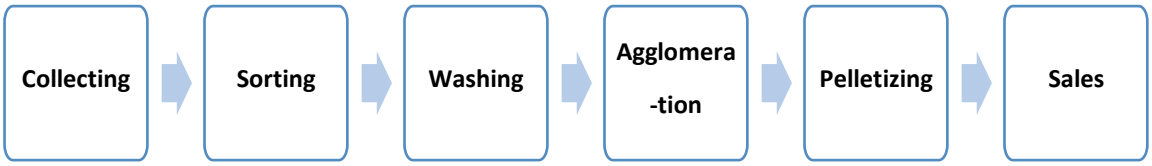

Figure 3. The recycling process undergone by the three companies.
Source: (Author, 2020)

Collecting: plastics are first acquired and weighed. However, because the solid waste is rarely separated at source, separation into organics, glass, paper, metals and plastics has to be done on site. Due to the cumbersome and time-consuming nature of this exercise, varying monetary discounts are offered to suppliers who provide waste that are separated in the components above. One of the companies that engages in pick up services ensures that all their waste is separated at source to make this process easier.

Sorting: after the plastics are collected, they are stored temporarily in the recycling plant and then, machines sort the plastics into categories such as the type or

color of the plastic. This process can either be done manually, automated or a combination of both. One company with the capacity to fully automate this process deliberately allows manual interventions in order to retain persons as factory waste pickers. The plastics are then separated into four groups either HDPE, LDPE, PET or PP. Each group is processed independently. This is important because plastics must be processed in different ways. Unfortunately, the three recycling companies are only capable of two of such processes.

Washing: plastics need to be washed to remove impurities which are non-plastics. Hence, after sorting is completed a machine is used to wash the plastics. The washing process is extremely important because much of the plastics recycled are packages and containers and as such contain adhesives, labels and food residue that need to be eliminated. A company stated that sachet water rubber is exempt from this process as they have to be dried after washing since they collect water. After cleaning, the plastics proceed to the next stage known as agglomeration.

Agglomeration: after the plastics are washed, they are resized by being shredded into small flakes. This is to facilitate reshaping and transportation where necessary. This process also acts as a final cleaning stage to get rid of impurities that should have been eliminated in the first three processes. After being shredded, the plastics are heated till their melting point is attained. They are then in their molten state immediately transitioned into the final stage (pelletizing).

Pelletizing: at this stage the plastics which are in a molten state are shaped into pellets. This can be used for further production of plastics. Once these pellets are generated, a tonne of them is worth between GHC3,000 - GHC3,500 ($500 - $583). One

company exports these pellets to Europe, China and Singapore whilst another only ends at the sorting stage and supplies it to local industries for their manufacturing process. For the third company, the plastic pellets are not sold but transferred to a sister company to be processed into polythene bags of varying sizes.

One company stated that this recycling process sometimes involves moving waste through different plants as some plants are specialized in particular stages of the process. This must be thoughtfully done to reduce operation cost and time spent. "*For every 1 tonne of plastic waste processed, the end product is around 0.7 tonnes because there is a 30% - 40% reduction in undergoing the recycling process."* This was stated by the operations manager of one of the companies. To provide a better understanding of the recycling process, an example utilizing a PET bottle will be employed.

4.2.3.1 PET Bottles

Figure 4. A picture of PET bottles.
Source: (Author, 2020)

From the data obtained, PET bottles are identified as valuable plastic waste. However, in Accra, they are often mixed up with other solid waste or found lining beaches. Ghana's production of PET bottles as at 2019 was 68,000 tonnes a year. In addition to the PET bottles that are imported, about 73 million kilos of plastic are released into the environment yearly. Only a meagre 2% undergoes recycling (Oppong-Ansah, 2020). Before arriving at the recycling company, the PET bottles go through the following process.

Figure 5. Process of PET bottles until their arrival at recycling companies.
Source: (Author, 2020)

Upon their arrival at the recycling companies, the beginning of the process is heavily dependent on the state of the bottles received. Two companies stated that the PET bottles are almost always mixed with other waste and as such have to undergo separation before washing, and then crushing them. One company, however informed the researcher that they educate and then require their clients to separate at source making it possible for these plastics to undergo washing and crushing upon reception without preliminaries. A general rate of 50 pesewas is paid for a kilogram of PET bottles received. Two companies after sorting the PET bottles just bale them. One exports them directly to Europe with the other to local companies who export on their behalf to Europe thereby acting as their intermediaries. This is done because they lack the necessary machinery for the further processing of this particular plastic waste.

Bales of bottles are forklifted broken up and dropped on a conveyor belt. They are then prewashed to get rid of any debris and trash. The bottles are then soaked in a hot soapy solution and are heated to the right temperature for their caps and labels to fall off. They are ground into flake-sized pieces. They are re-washed, dried and heated again to ensure that all contaminants are eliminated. Tests are performed to ensure that they conform to the standards of the Ghana Standard Authority and the flakes are shaped into smooth rice grain sizes (pellets) to be sold as raw materials to manufacturers.

After the final re-sizing, about a kilo is sold for 3 cedis. Most factories make the process easier by not only providing clean PET bottles but having a crushing machine on site for them to be crushed, bagged and sent to the recycling company for packaging and storage until they are ready to be transported. The final destination of these crushed PET bottles is China or other neighboring countries where they are used to make teddy-bear stuffing, car mats, and polyester fabrics like carpets among others.

4.3 Challenges Faced by Plastic Recycling Companies

Like all other businesses, plastic recycling companies experience challenges; internally and externally. Interestingly, all three companies in my interview with them shared the same problems. The core challenges identified by the companies were in relation to plant and machinery, governmental support and the apathetic behavior of the Ghanaian populace.

Plant and machinery: The startup capital required to set up a plastic recycling company is very high. Two companies disclosed that an average of $1,000,000 is needed but may differ based on quantity and quality. This high amount is as a result of the fact

that a lot of costly machinery and equipment are needed in this industry. For this reason, it is generally expensive to set up a recycling company because of the expensive machinery involved. The price to acquire a simple PET crusher can range from $10,000 - $80,000. Moreover, the companies face challenges maintaining machines. This is due to lack of specialized labor to operate the plants. Almost, if not all recycling machinery, are imported from China, India, Germany and Sweden due to the low quality and incompetence of the local ones. As such, obtaining plant and machinery is a challenge that inhibits players from entering the industry to unburden its presently overworked players as the quantity of recyclable plastics is beyond their combined capacity.

One company stated that unlike the past 6 years, power supply is currently stable prolonging the life span of machines and reducing operation cost. Unstable power supply reduces the life span of the machines and imposes on companies the financial burden of purchasing new machines.

Another challenge under this point is the lack of skilled personnel to operate and maintain the machinery. Knowledgeable people are vital to increase productivity where the quality of recyclable materials is poor and maintenance is infrequent. The persons interviewed admitted that it is difficult and expensive to recruit skilled people to operate the expensive machinery imported from more technologically advanced companies. The companies disclosed that since their machines are not Ghanaian made, acquiring locals with the requisite skillset to operate and manage the machines has proven almost impossible. In house training has therefore become a necessity and in some circumstances so has the hiring of skilled expatriates. These two practices are unwelcome additional expenses to what is an already capital-intensive operation. The former practice may also

result in low productivity for a period since it may take personnel undergoing training a while to complete their training and to adjust.

Quality of recyclables: the quality of the plastics largely depends on the waste received from suppliers. The interviewees mentioned that the general quality of the plastic waste processed in Accra is very poor. This is due to the fact that, separation is not done at source causing plastic waste to be mixed with other waste. Some of the plastic waste obtain too much impurities and experience an irrecoverable structure deformation. With the exception of a few schools, households and businesses that are ecologically conscious to ensure the quality of their recyclable materials is high, plastic waste supplied to recycling companies arrive in a poor shape. Occasionally, odd items like a garden hose, and other peculiar odds and ends like wires get trapped in the equipment and cause expensive damages.

Government: A resounding complaint amongst the interviewed companies was the lack of support by the government in the form of pro recycling legislation and financial aid.

Pro recycling Legislation

In Ghana's Environmental Sanitation Policy (1999), recycling is listed as a solid waste disposal option. However, recycling is the last option. Very little effort was made by the policy to describe recycling or explain what it entails. Comparing Ghana's waste disposal with that of the waste hierarchy of the ISWM framework, Ghana's waste hierarchy appears to be inverted. Moreover, there is no section for even reduction and prevention that can be aspired to. They include sanitary landfills, controlled dumping

with cover, incineration, composting then recycling. Under recycling it just stated that it should be encouraged for items such as plastic and bottles to be recycled and used as inputs for production (ESP, 1999). There is no legislation that directly makes recycling obligatory and deliberately outlines the process to undertake recycling. If Ghana continues to rely on outdated methods in disposing its plastic waste the country would digress and not be at par with the World Bank (2018) requirements outlined in the literature review and would not achieve SDG 12 by 2030.

Even though there have been efforts made by private companies, the government and the society at large are not taking positive steps to support these companies. The deficiency of the Ghanaian legislative framework for solid waste disposal is made more glaring when it is compared to the Solid Waste Disposal Act (SWDA) of the USA. Ghana does not have a comprehensive Act that addresses solid waste management or disposal. Instead, direct and indirect scanty provisions on solid waste disposal are scattered in different legislations (Ampofo, 2015). The SWDA of the USA on the other hand, is well outlined and detailed to prevent ambiguity and ensure effective enforcement. The attitude of the two countries towards recycling is reflected in their legislations on recycling. The SWDA dates as far back as 1965 and has impressively been amended frequently over the years to accommodate the development of recycling technology and to establish a system of recycling. The latest amendment to the Act was made in 2018.

The SWDA portrays a society that has made a commitment to progress in their solid waste management strategies amongst which includes recycling. Ghana unfortunately cannot be commended for such an effort. The ESP policy which is the only legislation that mentions recycling has been unchanged since 1999; the year it was first

promulgated. Analogous to their policies, the results of both countries concerning recycling are starkly different. In the United States, recycling has created 757,000 jobs with wages adding up to $36.6 billion. The government of the US has reaped about $6.7 billion as taxes from the recycling industry alone (US EPA, 2016). However, Ghana has no information that directly provides the employment, wages and taxes obtained from recycling, highlighting the little interest the government has in recycling.

Financial Aid

A unanimous complaint amongst the participants is the lack of financial aid from the government for the social good they are providing. The government has not once extended support to the recycling industry unlike it has done for sectors such as agriculture. This is juxtaposed by the fact that Ghana has an environmental tax. The tax is a 10% levy on raw and semi-complete plastic materials and some plastic products. It can be considered a type of Extended Producer Responsibility (EPR). This has been implemented since 2011 and has gained GHC 912 million ($152 million) (Ampofo, 2015).

However, till date since a fund secretariat has not been set up, the funds were instead paid into the government consolidated fund. Efforts have been made and are still being made for the funds to be released to support the plastic recycling industry for it to function as intended. It remains doubtful that the funds would ever be released to serve its purpose. It is suspected that the funds may have been used for other purposes. This challenge of insufficient funds on the part of recycling companies was identified by Troschinetz (2005) in the literature above (Chapter 2) as a hindrance to sustainably managing the solid waste in developing countries.

One company stated that almost all the recycling firms in Ghana are private therefore the entire cost of setting up such an establishment is borne by the investors and shareholders. Governmental intervention would be welcome in this exorbitant process to provide some financial relief to the firms. Though it may be costly to the government, the World Bank (2018) stated that it is worthy investment as the cost in addressing the associated effect will be higher for a city. Investing in the recycling industry will eventually obtain the government a return of minimal to no expenses for poor sanitation.

The lack of government support is worsened by the reality that the recycling companies have no organization, association or unified body to represent them. They are therefore unable to communicate their concerns to the government. Another disadvantage is their inability to share knowledge, experience and growth strategies they can employ. The companies consulted were either members of Ghana Plastic Manufacturers Association or Environmental Services Providers Association. However, none of these groups is solely for recycling companies.

Apathy: as discussed above, the law and government of Ghana lack an enthusiasm towards recycling making it only natural for the citizens to exhibit same. With an environment that is so passive towards recycling, it is no surprise that Ghanaians care little for recycling. The vast majority of Ghanaians dispose their solid waste using traditional methods because recycling has not been properly introduced to Ghana. In developed countries, systems are made to make recycling more convenient, some countries possess what may be described as a culture of recycling. The apathy of Ghanaians towards recycling is but a reflection of the apathy of the government and laws

towards recycling. An involved government and effective laws would also result in an involved people.

4.4 Recycling and wealth creation

The general sentiment shared by the companies interviewed is that whilst recycling has immense potential to create wealth, the challenges present in the Ghanaian industry prevents it from doing so. Two of the companies reported to make some profit but explained that business-wise, the profits were not large enough to be considered healthy. The third company admitted to breaking even and struggling to make profit which has been affecting the company. This company lamented its primary purpose is to perform a social service not to make profit yet still it feels the sting of the slow profit as this has hindered its ability to expand and increase capacity. No company provided figures or data to support this information as such information is considered confidential.

The three companies agreed that there is indeed a relationship between recycling plastic waste and increased wealth creation. However, there are some lurking variables that change the results of this relationship. If the challenges discussed above are addressed, the results of the positive correlation between plastic recycling and wealth creation would become even more evident. Below are some economic benefits of recycling to Accra and why this industry should be prioritized, and its challenges addressed.

Employment

Addressing the problems identified would not benefit the companies interviewed but the entire recycling industry leading to the creation of employment. For example, RAMAPLAST a company with 48 employees recycles sachet water rubbers to produce

eco-friendly school bags. It has produced 10,000 bags thus far and aspires to create 500 job opportunities and make 700,000 by 2023 (Agyeman 2019). This noble aspiration would be impossible to achieve with the present challenges facing the industry. Leaving the identified problems unresolved would hinder recycling companies from expanding at the rate they ought to, wasting an avenue to create employment and boost the nation's economy.

Aside recycling companies, there are several startup initiatives that are providing numerous jobs that will also gain an advantage should these challenges be addressed, and the industry improved. An example is the Recycle Not a Waste (RECNOW) initiative which recycles plastic waste into everyday products and fashion items. This project has provided employment and income opportunities for over 25 disadvantaged young people in Accra. They are employed to collect the plastic waste from their neighborhood and then process them into products such as bags, jewelry, footwear and home decor that are ethically produced and eco-friendly (Adu-Domfeh, 2012).

Revenue

Plastic waste recycling leads to increased revenue generated from tax and foreign exchange for the state. Ghana gains quite a significant amount of dollars from exporting recycled plastics to our neighboring countries that include Togo, Ivory Coast and Nigeria. This also allows the country to save some foreign exchange that may have been used to import raw plastic. These recycled plastics function as resources to produce sign and information boards, bags, litter bins, and litter bin bags among other items that would have otherwise been imported. Also, increased employment leads to increased tax revenue (Yahaya, 2013).

Industrial and commercial purposes.

Plastic waste is recently being used to produce plastic oil which is used to lubricate machines used in industries. The Director of the Ministry of Environment in Ghana in 2013 revealed that should the country be able to recycle a lot of plastic waste into machine oil, it could bring in foreign exchange that could even compete with that of cocoa. In exporting this oil, the country would be able to save millions of foreign currencies that would have been used to import this machine oil. Ghana should do well to emulate China, Kenya and Mauritania who are leaders in this endeavor (Yahaya, 2013).

Energy recovered from plastic waste can be a main contributor for energy production. Plastics can be incinerated and used as alternative fuel like coal in several industry processes. The energy content in plastics can be recovered through thermal and chemical processes. This energy can help augment the current shortfalls of energy supply in Accra (Yahaya, 2013).

India discovered that a plastic-bitumen mix produced from 1,381 quintals of plastic waste was enough for a 138 kilometer stretch of road. This venture utilized plastic waste such as carry bags, disposal cups and laminated plastics like pouches of chips, aluminum foil and packaging material such as biscuits, milk, and grocery items for surfacing their roads. If the plastic waste could be 15% constituent, this would promote the conserving of an equivalent measure of asphalt thereby lowering the general cost of constructing the road (Vishal Gulati, 2010).

The US Embassy (2019), estimates that Ghana can provide 5 million jobs, and make GHC 2 million ($345,547) from recycling these plastics (Larnyoh, 2019). Should all stakeholders including the government cooperate effectively, recycling could become

one of Ghana's most profitable ventures. However, the challenges outlined above must be defeated to accomplish this.

Below are some vehement opinions of personnel from the waste management companies:

- *"The landfills in Accra are overworked."*

- *"Poor engineered landfill sites lead to vehicle breakdown."*

- *"Poor enforcement of sanitation bye-laws and regulations."*

- *"I do not think Ghanaians can ever change their habits to recycle at source; though we would really appreciate if recycling is done at source."*

Below are some vehement views of personnel from the recycling companies interviewed:

- *"The government really needs to help us with regards to funds".*

- "*Though we are providing a social good, the government has turned a blind eye to us."*

- *"Separation of waste needs to be done at source for the survival of the plastic recycling industry."*

- *"Should recycling of plastic waste be taken seriously and accorded the necessary respect, the economy of the country will benefit through job creation, revenue, tourism, research and academia.*

CHAPTER 5: CONCLUSION

5.1 Conclusion

This study sought to explore recycling as a strategy for revenue generation and municipal plastic waste management. The researcher deemed the Accra Metropolitan Area as appropriate for the study because of its high level of commercial activity and progressive increase in plastic waste generation. To gain insights into Accra's recycling industry, recycling companies, waste management companies and the office of the AMA were consulted to solicit their views. This section outlines the concluded findings of the research, recommendations, limitations and areas for further study.

5.2 Summary

Over the years, Accra has battled to manage its plastic waste. This stems from the augmented generation of solid waste. In 2013 alone, Accra produced 2,000 metric tonnes of solid waste daily which grew to 3,000 tonnes by 2018. Of this solid waste, 17% is plastic waste. Unfortunately, plastics are non-degradable and cannot be eliminated but rather recycled to be reused. This is because plastics averagely take between 450-1000 years to decompose and as such the use of landfills as a waste management strategy for plastics has caused serious health repercussions such as respiratory diseases, leukemia and eye irritations. This study therefore sought to prove that recycling is not only an ecologically sustainable waste management approach, but it is also an economic activity with a high potential to generate wealth.

In Ghana, 2.58 million metric tonnes of plastics are annually imported with 73% ending up as waste and 19% been recycled. To curb this, recycling has been established the solution to significantly address this problem. Ghana has the potential to generate

GHC 1.2 million yearly through the recycling of plastic waste. To accomplish SDG 12, it is necessary to build a system in Accra that seeks to create synergies that are implementable to generate revenue through recycling.

The underlying framework for this study is the ISWM which analyzes the processes in the management of solid waste right from prevention to the disposal, inviting all stakeholders to participate in the process. The study however focused on recycling and its economic benefits. Some of these benefits include job creation, conservation of natural resources and decrease in the cost associated with landfills, air and water pollution.

Secondary and primary data sources were employed in this research. For the primary research, the researcher adopted the qualitative research design; specifically, semi structured interviews to accomplish the objective of the research. The sampling procedure was purposive, and non-probability sampling technique was used to choose the desired three recycling companies. The findings were then analyzed using a thematic structure.

5.3 Main Conclusions

From the data gathered and the findings obtained, it was realized that although the plastic recycling industry is beneficial to the city of Accra, it is presently underdeveloped and unstructured. There is currently no association for companies who recycle in Accra. This leaves the survival of each recycling company solely in its own hands. Plastic waste in Accra is sourced from industries, businesses and residences. The types of plastics recycled are PP, PET and PE. PET bottles and sachet water rubbers are the most common recyclables. The major challenges that recycling companies are facing include challenges

with procuring and maintaining of equipment, lack of governmental support, and the apathetic attitude of inhabitants.

Recycling equipment are usually imported from other countries, making them expensive to procure and maintain. The legislative framework for disposing waste does not address the recycling process or the recent developments in solid waste disposal and management. Recycling companies do not enjoy tax exemptions like some other sectors causing the few recycling companies to bear the full cost of running the expensive process of recycling. The public remains very apathetic towards recycling almost treating it as an inconvenience.

5.4 Recommendations

For a successful implementation to boost the current recycling industry in Accra, stakeholders must initiate changes in policies, provide adequate funds and infrastructure as well as monitor consumption patterns. Below are some recommendations based on the challenges experienced by the recycling companies:

Lack of governmental support: it is highly recommended that specific legislations be made and enforced to require firms that produce and use plastic packaging to ensure that these products are not carelessly littered about by consumers when they are done using the product. This would help to ensure producer responsibility as these businesses are held accountable for the plastic waste created from their consumed products. Manufacturers should also be mandated to utilize recyclable materials as raw materials in their production. Furthermore, the manufacturers of plastic waste should be closely monitored to ensure that they comply with the laws concerning their production process. To

add on, a legislation should require the compulsory recycling of plastic waste by residents, so that separation of solid waste becomes a habit. To accomplish this, information can be made available on how to recycle plastics and the respective separation (groups) needed for plastic waste and the provision of necessary bins. This would encourage recycling at the communal level like what is done in countries such as Germany and Japan.

The government can allocate funds from its budget to recycling companies in their acquisition of equipment and machinery through subsidies or the provision of tax exemptions to cushion the current high operating cost of recycling companies. Private public partnerships can also be undertaken by potential investors to raise capital to expand this industry. A good business environment can be created where tariffs on electricity and water can be reduced as these components are key operating expenses. Soft loans made for entrepreneurs veering into the industry would also be a good strategy.

Equally important as a recommendation, the creation of a plastic recycling association for the recycling companies will provide them with the benefits professional associations offer: – a unified voice and an opportunity to network and learn from each other and figure out innovations and new developments within the industry.

Partnerships can be established with countries like Germany, Austria, South Korea and Sweden not only to purchase machinery but also to educate recycling companies on the reasons for their successful recycling systems. Thus, seminars, workshops and training programs on how their machines are maintained and how the recycling process is carried out as well as buying and selling contracts can be agreed on to contribute to reducing plastic waste in Accra.

To tackle the problem with the behavior of Ghanaians, education (formal and informal) and incentives should be used to promote ideas necessary to encourage the participation of households to undertake the waste management process. It was established that in the presentation of information to households, when environmental and economic benefits are both together, it results in behavioral change rather that incentives alone (Addei, 2016). Public seminars, school curriculum, brochures, as well as radio and television advertisement should be the foundation of an intensive campaign on the necessity of separation at source and the need to reduce plastic waste generation.

Incentives through a communal buy back system of plastic waste would push people to recycle as this process not only creates jobs but also provides raw materials to be used by local industries. This is exactly what was launched by a recycling company (Coliba) in Accra this year. It being supported financially by UNDP and the Netherlands Embassy of Ghana. Their aim is to collect 5.6 tonnes of plastic waste in a month and generate 67 tonnes a year and give back GHC 2,800 ($467) monthly to the community (UNDP, 2020). This is a laudable initiative and should be encouraged.

The social responsibility for the recycling of plastic waste should be implemented especially in the educational system right from primary school until it becomes a culture. Universities, secondary and primary schools should instill and provide for the separation of plastics at source. The role that members of the community such as religious and youth groups play in plastic waste management should be strengthened.

The formal involvement of scavengers (informal waste recyclers) would promote an efficient environment as it will not only help reduce cost but also enable the waste to be collected from areas that can be potentially inaccessible to trucks.

If these recommendations are taken into consideration, existing recycling companies will grow their capacity and expand. New competitors will also be motivated to enter the industry. Moreover, the implementation of these recommendations would help contribute to President Nana Akuffo-Addo's vision of Accra being recognized as one of Africa's cleanest cities. The expansion in this industry can also enable Ghana to climb the waste hierarchy level to reduce and prevent waste as explained by the ISWM framework. Ghana may even progress to the stage of other developed countries where stringent measures such as banning of plastic bags are enforced to reduce and prevent plastic waste.

This research is significant because the results and recommendations of this study should be of interest to the Ministry of Environment, the Accra Metropolitan Assembly, Municipal District Assemblies and waste management companies. It will also contribute to existing literature on recycling. Below are some limitations encountered whilst undertaking this study.

5.5 Limitations

- The respondents were generally receptive, a few were suspicious and afraid to provide information as they felt it may be used against them.
- Contacting respondents for follow-up questions to receive clarification proved difficult. Although it was easy to gain access to the interviewees, during the follow up phone calls, it was hard to reach them.
- A pilot test with the interview guide was necessary but due to time constraints it was not conducted.

- Although the informal sector (plastic waste pickers) contributes significantly in recycling plastic waste as stated in the literature review, the researcher could not contact them directly due to time constraint but gathered data about them from the recycling companies.
- Considering the focus of this study, revenue and cost figures of the recycling companies would have been useful but the companies were unwilling to make such information available to support the literature.

5.6 Areas or Further Study

Further research could be conducted to identify how the informal sector can be boosted and capitalized on in the sustainable utilization of plastic waste generated in creating jobs for unskilled youth in Accra. Also, a study can be conducted on how the psychological behavior of Ghanaians can be adjusted to ensure that recycling is judiciously done at source.

A study can be undertaken to discover if environmental social enterprises have a part to play in promoting recycling of plastic waste in Accra. A further study could be done to assess the wealth benefits of recycling organic waste (composting) and its role as a municipal solid waste management approach. This would be necessary as organics constitute a significant amount of the solid waste produced in Accra.

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APPENDIX

INTERVIEW GUIDE

Alliance Waste and Zoomlion Company

Section 1 (Demographics)

Type of staff: …….

Section 2

1. How many tonnes of solid waste are produced daily?
2. What type(s) of solid waste are produced in Accra?
3. What percentage of the solid waste are plastics?
4. What are some problems facing the department in their bid to manage solid waste?
5. How can these problems be addressed?
6. What is the cost incurred monthly for collection of waste?
7. What is the associated revenue?
8. Do you have a relationship with the companies who recycle?
9. How is the solid waste collected disposed?
10. Before plastics are disposed, are they separated? (that is grouped into plastics, metals among others).
11. What is your view on the revenue that can be generated from recycling the municipal plastic waste?
12. What is your view on how it can be effectively implemented?

INTERVIEW GUIDE

3 Recycling Companies (IRECOP, ACARP and Jekora)

Name: …….

Present Condition

1. Are there enough players in this industry?
2. What is the type(s) of plastic waste recycled by this company?
3. What operation process is undergone with the plastic waste obtained?
4. What is the company's capacity? What is the capacity your company is currently operating at?
5. How many tonnes of plastics are recycled daily?
6. What is your relationship with the waste management companies?
7. How do you generate employment?

Problems Encountered by Recycling Companies

8. What is the state of the plastic waste received before undergoing recycling?
9. What are the views of the people of Ghana on recycling?
10. What is your view on the revenue generated by the company?
11. Recommendations on how the menace of how poor plastic waste management can be curbed in Accra.
12. What are the economic benefits your company can offer the state, should it grow?
13. Are there legislations that exists that promote or impede your operations?
14. Are funds or any form of assistance provided by the government to your company to promote recycling?

INTERVIEW GUIDE

Office of The Accra Metropolitan Assembly

Section 1 (Demographics)

Type of staff: …….

Section 2

Challenges Experienced

1. Are there current problems experienced in controlling the plastic waste in the Accra Metropolitan Area?
2. Propose solutions for how these challenges can be addressed.

Revenue generation and cost incurred

3. In a month, what is the cost incurred for the co-ordination of waste collection?
4. In a month, how much revenue is generated from this activity?
5. What percentage of the budget is put into the sustainable management of municipal plastic waste?
6. How much cost is directly incurred in addressing the effects of improper disposal of plastic waste?