

ASHESI UNIVERSITY COLLEGE

**The Wealth of Plastic Recycling: A Comparison between Plastic Recycling
Companies in Accra and one in Gauteng, South Africa, for Improvement Purposes**

THESIS

Thesis to be submitted to the Department of Business Administration, Ashesi University
College in partial fulfillment of the requirements for the award of Bachelor of Science
Degree in Business Administration

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April 2016

Declaration Page

I hereby declare that this Dissertation 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.

Candidate's Signature:.....

Candidate's Name:.....

Date:.....

I hereby declare that the preparation and presentation of the Applied Project Report were supervised in accordance with the guidelines on supervision of applied projects laid down

by

Ashesi University College.

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Supervisor's Name:.....

Date:.....

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Abstract

Accra, the capital city of Ghana is one of the fastest growing cities in Africa. This has led to the daily generation of about 2,000 tons of municipal waste. Accra faces a situation in which plastics, the second largest component of waste produced is disposed of primarily through dumping and landfills although plastics do not decompose. However, recycling which is a preferable alternative for disposing of plastics and a profitable industry accounts for about 5% of the waste disposal methods used in Accra.

The objective of this paper is to describe the current state of recycling in Accra and draw lessons from a recycling company in Gauteng, South Africa, in order to improve upon the plastic recycling industry in Accra. Non – probability sampling was used to select recycling companies in Accra to partake in the study. A South African plastic recycling company was also involved in the study in order to understand at first – hand the processes involved in plastic recycling in South Africa.

The findings show that the plastic recycling industry in Accra is largely unstructured. The technology available to plastic recycling companies accounts for the major difference between the output of the companies in Accra and the company in Gauteng. As such, the government of Ghana should support this sector by partnering with the companies in order to equip them with advanced technology as their activities contribute to the sanitary conditions that exist in Accra.

Key words: Plastic recycling, supply of materials, technology, government of Ghana

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List of Definitions

Plastics – A plastic is a lightweight material made of a combination of different elements such as carbon, carbon, hydrogen, oxygen, nitrogen, chlorine and sulfur which possess a wide range of uses.

Plastic Recycling – Recycling is the process of grinding or melting already used plastic in a bid to turn them into new products.

Plastic recycling company – A plastic recycling company is a company that undertakes the process of grinding or melting used plastic in a bid to turn them into new products in order to generate income.

Wealth – Wealth is the possession of an abundance of money, valuable possessions

List of Acronyms

AMA – Accra Metropolitan Assembly

CSIR - Centre of Scientific and Industrial Research

HD – High density polyethylene

ISWM – Integrated Waste Management System

LD – Low density polyethylene

MDGs - Millennium Development Goals

OAT - Office of Appropriate Technology

PET - Polyethylene terephthalate

PS - Polystyrene

SDGs - Sustainable Development Goals

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CHAPTER 1: INTRODUCTION

Background

Waste Produced in Accra and Waste Disposal Methods

Accra, the capital city of Ghana has a population of about 2.9 million people. As one of the fastest growing cities in Africa, urbanization and changes in material consumption and lifestyle have led to the daily generation of about 2,000 tonnes of municipal waste (Annepu & Themelis, 2013). This implies that about 730,000 tonnes of municipal waste is generated each year, yet the waste collection and management system is not well structured to effectively dispose of the waste that is produced.

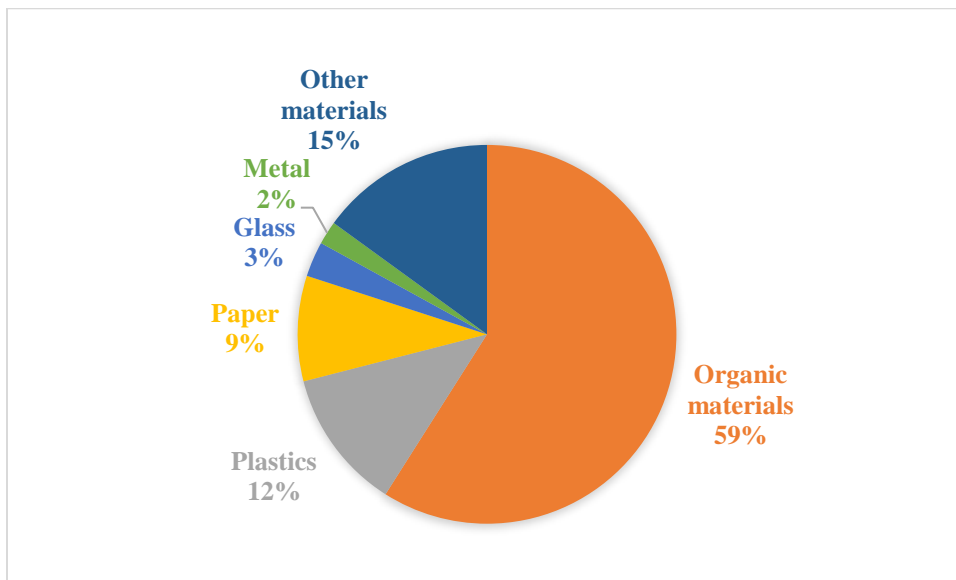


Figure 1. Composition of waste in lower - middle income countries (Hoornweg & Bhada-Tata, 2012)

Out of 2,000 tonnes of waste that is generated each day, the Accra Metropolitan Assembly (A.M.A.) is able to collect 75% of the waste (Accra Metropolitan Assembly [AMA], 2013). According to the breakdown of waste from the 2012 Urban Development Series

Knowledge paper on “A Global Review of Solid Waste Management” shown in Figure 1 above, typically in lower – middle income countries, waste is made up of 59% organic materials, 12% plastic, 9% paper, 3% glass, 2% metal and 15% other materials (Hoornweg & Bhada-Tata, 2012). A report by the Millennium Cities Initiative on the findings of the waste composition for the Aryee Diki electoral area in Accra New Town shown in Figure 2 below presents that organic material accounted for 67% of solid waste, plastics was 20%, textiles was 5%, paper was 4% and metals and glass 2% (Alhassana, Gabbayb, Melara Arguellob & Boakye-Boaten, n.d.)

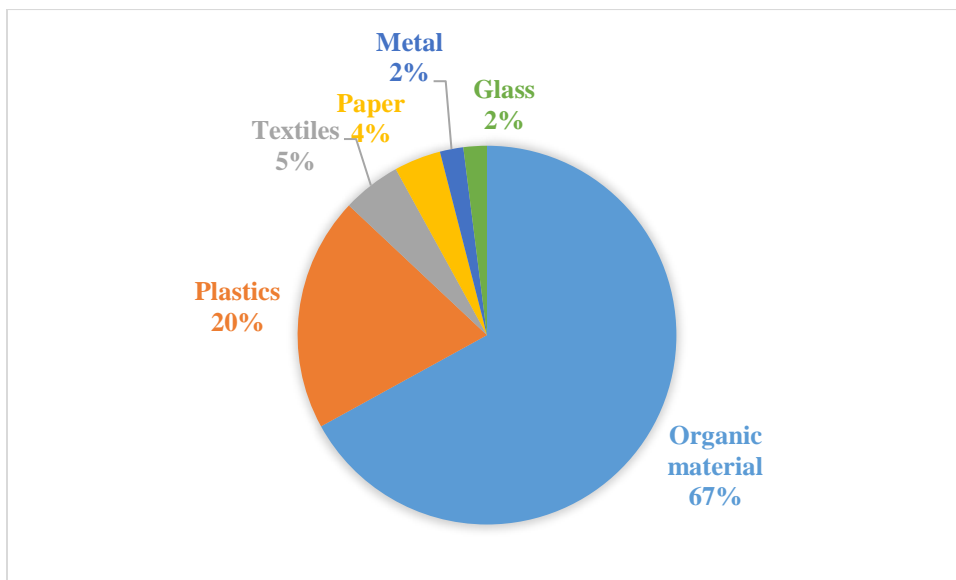


Figure 2. Composition of waste in Aryee Diki electoral area in Accra New Town (Millennium Cities Initiative, n.d.)

Comparing the findings mentioned above, it is clear that next to organic materials, plastic waste is the second major component of waste produced in Accra. Organic materials are derived from the earth and have the ability to decay thus become a part of the environment after use. Plastics however, do not easily decompose and hence remain in the ground for a long time if deposited there. As shown in Figure 3 below, in lower middle income

countries, 49% of waste is disposed of through dumps, 11% through landfills, 2% by compost, 5% through recycling, 0.2% through incineration and 33% through other means (Hoornweg & Bhada-Tata, 2012). This shows that the most likely method of disposing of plastic waste is by dumping or landfills which together account for 60% of disposal methods in lower income countries.

However, recycling which is the most efficient method of disposing of plastics accounts for 5% of the waste disposal methods. It is important to note that recycling used in this context includes the recycling of different materials such as plastics, paper, metals and rubber. As such the percentage of plastic recycling carried out in Accra is much lower than 5% of waste disposal methods. This strongly shows that there is an opportunity for an increase in the volume of plastic recycling that is currently taking place in order to efficiently dispose of plastics.

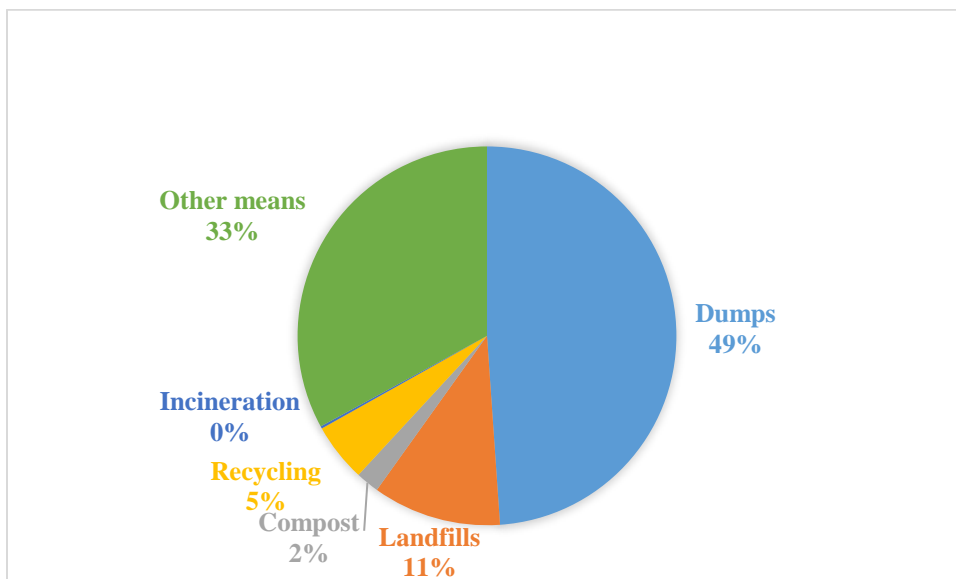


Figure 3. Waste disposal methods in lower - middle income countries (Hoornweg & Bhada-Tata, 2012)

The Wealth of Plastic Recycling in Accra

A study carried out by Centre of Scientific and Industrial Research (CSIR) shows that Ghana stands to gain GHS1,200,000,000 (\$315,789,474) every year if plastics are to go through the process of collection, sorting and resale to user agencies, however there is a deficit in the number of players in this industry (Ghanaian Times, 2013). This shows that the recycling industry is a profitable industry and that there are monetary gains that stand to be made within this industry. A study carried out by Owusu-Sekyere, Issaka and Abdul-Kadri shed light on some of the economic potentials of plastic waste collection and recycling in order to establish wealth linkages, drawing on the experiences from Kumasi Metropolitan area of the Ashanti Region. The conclusion of this study was that recycling is a profitable venture. Due to this, individuals depend on it for their livelihood (Owusu – Sekyere, Issaka & Abdul – Kadri, 2013). The works of Owusu – Sekyere et al., go to buttress the fact that the plastic recycling industry is profitable and due to its current small size there are vast opportunities to create value for money and contribute towards creating a cleaner Ghana.

Plastic Recycling in South Africa

South Africa is one of the world leaders in the mechanical recycling of plastics (Green Times, 2014), and recycles 18% of all virgin plastics for further use (McKenzie, 2012). This is as against Australia's rate of 9.2% and Europe's rate of 14.2% (Green Times, 2014). The industry is made up of about 221 recycling companies whose output is used locally to manufacture new products in the packaging, building and industrial industries (WastePlan, 2014). In South Africa, post-consumer use was the highest source of plastic waste in 2014 accounting for 63% of plastics recovered. (Plastics South Africa, 2015).

Plastic Recycling in Ghana

Troschinetz (2005) stated that there is an ignorance of the value of waste materials in developing countries and hence a lack of respect for recycling in carrying out a research to identify twelve factors that influence sustainable recycling in developing countries. Due to this, the recycling industry in developing countries has been described as young and informal. Information from the Accra Plastic Waste Management Program shows that 120 metric tons of waste is recycled on a daily basis in Ghana, with empty plastic water sachets accounting for about 40% of this figure. About 10,000 youth are employed in the sachet water production, plastic waste collection and recycling business sectors. Yet, most of the recycling companies operate on a small scale (Essel, 2015).

Transition from Millennium Development Goals to Sustainable Development Goals

Since adopting the Millennium Development Goals (MDGs) (eight anti-poverty targets) in 2001, Ghana has made some progress. According to the 2015 Report on the Ghana MDGs, Ghana has met the targets for halving extreme poverty (MDG 1A), provision of universal primary education (MDG 2A), gender parity in primary school and halving the proportion of people without access to safe drinking water (MDG 7A) (NDPC, 2015). The report went on to state that Ghana looks forward to the adoption of the Sustainable Development Goals (SDGs) also known as the Global Goals. The new set of 17 goals tackles the root causes of poverty (United Nations Development Programme [UNDP], 2015).

Of importance to this study is the twelfth goal which is labeled: “Responsible Consumption and Production.” It is stated within the goal that in order to achieve economic and sustainable development, there is the need to urgently reduce our ecological footprints by changing the way we produce and consume products. In effect, the target of this goal

among others is to encourage industries and businesses to recycle and reduce waste as well as encourage developing countries to move towards sustainable patterns of consumption by 2030 (UNDP, 2015). Increased recycling in the light of the adoption of the 12th goal implies that there should be an increase in the number, and efforts of recycling companies in Ghana with support from the government of Ghana in order to move towards sustainable consumption by 2030. Based on the context that has been described the problem statement is defined in the next section.

Problem Statement

A large volume of plastic waste is generated daily yet a small fraction of this is recycled. As such, despite the amount of recycling being undertaken the gap that currently exists in Accra is that there is a great disparity between the volume of recycling carried out as compared to the amount of plastic waste produced in Accra. Plastic recycling companies in Ghana are currently operating on a small scale and this contributes to the minimal effect of the recycling industry. This exposes the need for plastic recycling to be carried out at a much larger scale. This will ensure that investors as well as residents enjoy the benefits that come with plastic recycling. This gap will be approached based on the conceptual framework detailed in the next section.

Conceptual Framework

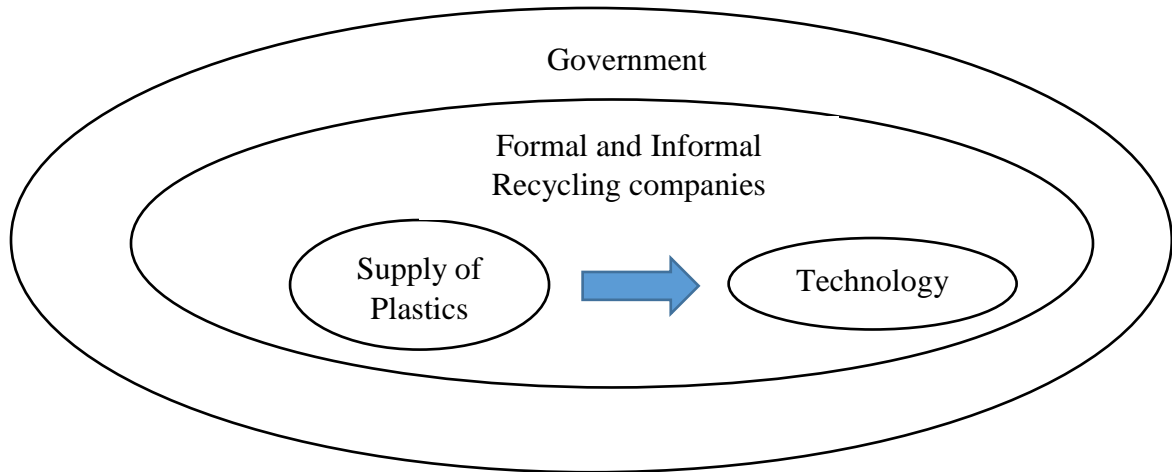


Figure 4. Conceptual framework diagram

An analysis of the performance of the plastic recycling industry can be carried out in different ways. These range from focusing on the behaviour and willingness of people in a country to recycle plastics, evaluating the legislation and policies that exist and their effect on recycling in a country or focusing on the companies and the challenges that they face. Aizen's theory on planned behaviour has been used to explain the waste recycling behaviour of individuals (Troschinetz, 2005). Using this theory, different authors have spoken about how it can be used to explain the effect that human behaviour has on the plastic industry in Accra. In terms of the role that legislation and policies play on the amount of plastic recycling carried out, Shinkuma carried out a study entitled "*On the Second – best Policy of Household's Waste Recycling*" to investigate the best household waste recycling policy considering the transaction cost involved in a recycling subsidy and possibility of illegal disposal by a consumer. The conclusion of the study is that the best policy depends on the price of the recycled good and the marginal transactional cost (Shinkuma, 2003).

The Integrated Sustainable Waste Management Framework (ISWM) is an analytical framework for assessing waste management services. It considers the institutional, social, environmental, technical and financial aspects of waste management system (Klundert & Anschutz, 2001). The elements of this framework are stakeholders as they have a stake in the management of waste, the processes involved in management of the waste and the regulatory, environmental and financial realities in which the waste management system operates (World Bank, 2012).

The conceptual framework used in this study was developed from the ISWM in order to understand the current state of plastic recycling companies in Accra. As seen in Figure 4, the main elements of the conceptual framework for this study are the sources of supply available to the companies, the technology involved in carrying out the research as well as the government support and the organizations that are create conditions within which plastic recycling companies in Accra operate. In the conceptual framework used in this study, the stakeholders are the management of the plastic recycling companies, the suppliers of plastic waste and the clients of the plastic recycling companies. Primary focus is placed on the suppliers of the plastic waste as they are crucial to the plastic recycling process. The processes element of this framework is the technology that is involved in the plastic recycling process. Finally, the regulatory and environmental aspect of the framework used in this research consists of a review of the effect of the government of Ghana's policies on the plastic recycling industry in Accra.

A study carried out by Troschinetz on twenty-three developing countries came out with twelve factors that influence sustainable recycling of municipal solid waste in developing countries. The conclusion of the study was that the education of municipal solid waste

management personnel, the availability of waste collection and segregation services and the budget allocated by government to municipal solid waste management were the three most significant barriers to sustainable recycling of municipal solid waste (Troschinetz, 2005). This further goes to show that the inclusion of government support in the conceptual framework used in this research is important as the government budget allocated to recycling is considered as one of the barriers to recycling. Using the framework detailed above, the objectives of the research are discussed below.

Objectives of Research

The objective of this paper is to describe the current state of recycling in Accra, identify the challenges that recycling companies are facing in terms of their supply of materials, technology and government support, and review how recycling is organized in a recycling company in South Africa to see lessons that can be drawn to improve upon the plastic recycling industry in Accra.

Research Questions

Based on the objectives stated above, the study seeks to answer the research questions below:

- What is the current state of plastic recycling in Accra? This includes the sources of supply for plastic recycling companies in Accra, the types of plastics they recycle, the technology currently used, the processes carried out and the final output produced.
- What are some of the most pressing challenges faced by plastic recycling companies in Accra in terms of their supply of materials, technology and government support?

- How do plastic recycling companies in South Africa organize their operations in order to provide wealth for themselves and their societies?
- What are the most important lessons that plastic recycling companies in Accra can learn from plastic recycling companies in South Africa in order to create more wealth for themselves as well as for the societies they operate within?

Significance of Study

This study will be of great significance to the government of Ghana as it will expose the challenges that plastic recycling companies are facing. This will better equip the government to provide support to help the companies improve upon their efficiency. According to the Ghanaian Deputy Minister of Health, Dr. Victor Bampoe, the economy loses \$735 million a year in lost productivity due to malaria in the corporate sector (Essabra – Mensah, 2015). Malaria is disease whose occurrence can be reduced by ensuring good sanitation and plastic recycling companies can contribute significantly to cleaner surroundings through their operations. Therefore it is important for the government of Ghana to understand the challenges accounting for the minimal effect of plastic recycling companies in Accra and to support them to improve upon the scale of their operations.

The Accra Metropolitan Assembly will also benefit from this study as it will give them information about how to support the plastic recycling companies as they are a key component to improving the sanitation situation in Accra.

This study will also be of great significance to recycling companies by contributing to an improvement in their processes drawn from comparisons between the local recycling processes and those implemented in other countries.

CHAPTER 2: LITERATURE REVIEW

This chapter is organized into three major sections. It begins by taking a look at the waste management hierarchy and its associated components. It then takes a look at plastics and recycling and then finally, it discusses similar studies in order to justify how this study is relevant and fills the gap stated in Chapter 1.

Waste Management Hierarchy

An article written by Wolf on Source Reduction and Waste Management Hierarchy mentions that the waste management hierarchy is an ordering of hazardous substances based on the effect they can have on the environment. The California Office of Appropriate Technology (OAT) in 1981 was one of the major actors that defined the optimal hierarchy of waste management. There have been many controversies on the component of the waste management hierarchy. Yet the simplest form of this hierarchy which enjoys a general consensus is source reduction, recycling, treatment and land disposal (Wolf, 1988).

The components of the hierarchy are arranged in order of safety; the most environmentally friendly to the least friendly, from top to bottom. At the top of the hierarchy is source reduction. It remains the most desirable option as it involves reducing harmful waste at the source. Once source reduction options have been used, the next option to be considered is recycling (Wolf, 1988). Recycling involves reclaiming material from the waste stream while reducing the volume of waste. Treatment and land disposal are at the bottom of the hierarchy and are considered as ‘last resort’ disposal methods. (Muzenda, 2014). This study will concentrate on recycling and the wealth benefits that exists within the recycling industry. Before going into detail about recycling we will discuss what plastics are in the next section.

What are Plastics?

According to the American Chemistry Council, the term “plastics” is used for materials that are composed of various elements such as carbon, hydrogen, oxygen, nitrogen, chlorine and sulfur. Plastics (also called monomers) are produced through the synthesis of chemicals from oil, natural gas or coal (American Chemistry Council, 2015). Plastics can be moulded into various shapes, drawn into filaments and used by textile fibers. Though each plastic has distinct characteristics, they all share some common traits; resistant to chemicals, lightweight, and easily processed to produce intricate parts. Due to these properties, plastics are used for various purposes; from packaging to home construction (American Chemistry Society, 2015). “Plastics” is also a term used for a range of synthetic or semi – synthetic materials which have a wide range of uses (PlasticsEurope, 2015).

There are two main categories of plastics based on processing: thermoplastics and thermoset plastics. Thermoplastics have molecules that are held together weakly by secondary forces that soften when exposed to heat but return to their initial position when at room temperature. They are usually used for food packaging because they can easily be moulded into different shapes. Thermosets on the other hand set irreversibly when exposed to heat. They are durable and hence used in automobiles and construction as well as applications such as adhesives and coatings (American Chemistry Council, 2015). The next section touches on the different types of plastics.

Types of Plastics

While there is a wide range of plastics commercially available in developed countries, the opposite is true for developing countries; there is only a small range that is available. The four types of plastics that are used and commonly recycled are polyethylene,

polypropylene, polystyrene and polyvinyl chloride (Ampofo, n.d.). Polyethylene is hard and stiff and can be sterilized. It is usually used to make bottles and shrink – wrapping products. Polypropylene is lightweight and tough but not strong. It scratches easily and is resistant to chemicals. As such, it is used for large - scale construction products. Polystyrene is lightweight, hard, stiff, transparent and brittle and can be moulded into a variety of plastics. Polyvinyl chloride is stiff, strong, tough and scratch - resistant. As such, it is used for used to make two and three dimensional forms (BBC, 2014). The next section goes on to discuss the subject of recycling.

Sources of Plastic Waste in Accra

Plastic waste in Accra is created from industrial, commercial and municipal sources. The industrial sources include plastics processing, manufacturing and packaging industries which provide clean sources of plastic waste as compared to the commercial and municipal sources. This is because the plastic waste is not mixed with a lot of materials during its production and hence are free from impurities and ideal for reprocessing. Automotive industries, construction and electrical industries are usually the suppliers of such plastic waste (Ampofo, n.d.).

Commercial sources of plastic waste include supermarkets, hotels, restaurants, offices and craftsmen workshops. They also provide reasonable volumes of plastic waste which is usually in the form of plastic packaging made from polyethylene. Municipal sources are from waste found in residential areas. As such it includes household waste, waste on streets and roads and waste dumps. Sachet water bags are a big component of waste from municipal sources (Ampofo, n.d.). After plastics have been created from the above mentioned sources what harm can they cause if they are not disposed of properly? The next

section will briefly mention some of the harm that plastics cause when not disposed of properly.

Harm Plastics Create when Improperly Disposed

One of the major effects of improper disposal of plastic is the choking of drains in Ghana. This usually leads to flooding in some parts of Accra when it rains. Also, a number of the beaches are littered with plastic sachet bags used for selling water. Not only does this turn the beach into insanitary spaces which are an eyesore but this also drives away tourists. The choked drains also end up serving as breeding grounds for mosquitoes leading to outbreaks of malaria (News Ghana, 2012). Cholera, a disease caused by the intake of contaminated food is also a result of insanitary conditions caused by conditions such as choked gutters.

According to the AMA, malaria accounts for 95% of out-patient department cases in Accra and cholera has become an epidemic with seasonal outbreaks which coincides with the rainy season (AMA, 2013). The World Health Organization also stated in 2015 that in Ghana, malaria accounted for the highest number (20%) of deaths in children under five while diarrhoea was the sixth largest factor accounting for 8% of deaths (WHO, 2015).

The Deputy Minister of Health of Ghana, Dr. Victor Bampoe stated that the economy of Ghana loses \$735 million a year in lost productivity due to malaria in the corporate sector. He stated that in 2014 businesses spent an average of 0.5 percent of their annual corporate returns on treating their employees and their dependents for malaria (Essabra – Mensah, 2015). The proper disposal of waste through recycling is one that will ensure that plastic waste is efficiently managed in order to reduce the attendant problems that come with improper disposal.

Recycling of Plastics

Recycling can be described as the process through which plastic is re-melted and formed into new products (Carlsson & Reich, 2002). Through the process of recycling, plastics that have been previously used can be turned into new products in order to reduce the volume of municipal waste thus facilitating the efficient disposal of waste. Zikmund and Stanton stated that the process of recycling is slightly unusual from a marketing standpoint because the end consumer who uses a product undergoes a role change once he recycles his waste materials. For example, a consumer who recycles his plastic bottles becomes the de facto producer of the waste materials, making the consumer the first link in the distribution channel. In effect, recycling is a “reverse distribution” process that is carried out through a “backward” channel in which reusable packaging and other waste products are returned to the producer (Hoornweg & Perinaz, 2012).

Recycling is usually carried out by the informal sector in lower - income countries. The occurrence of plastic recycling is high in local markets which are usually poorly regulated recycling markets. With middle- income countries, the informal sector is still involved. Some level of high technology is employed in sorting and processing and recycling markets are somewhat regulated. In the case of high - income countries, advanced technology is used to sort and process the materials within a regulated market. Recycling rates tend to be higher in developing countries than in low and middle - income countries (Hoornweg & Perinaz, 2012).

The next section briefly describes the process of recycling as carried out within Europe in order to give a background to the topic.

Process of Recycling

Plastic recycling has been considered a complex process due to the different forms of recycling and recovery activities that can be carried out. The process of recycling can be grouped into four categories. To begin with, primary recycling involves mechanically reprocessing plastic to produce a product with equivalent properties. The next is secondary recycling also known as downgrading. This involves mechanically processing plastics into products that possess lower properties as compared to the original plastics. Tertiary recycling, described as chemical or feedstock recycling, involves the recovery of chemical constituents. Quaternary recycling is the recovery of energy from waste (Hopewell, Dvorak & Kosior, 2009).

The process of post-consumer recycling is made up of the following key steps: collection, sorting, cleaning, size reduction and crushing. The collection stage is usually carried out through the use of “bring-schemes” or curbside collection. Curbside collection has generally been relatively successful and involves the collection of different types of recyclables such as paper, glass and aluminium. Bring-schemes require high public participation, which unfortunately is usually low. The sorting of co-mingled recyclables can be carried out through the use of automatic or manual methods. Of the two methods mentioned the automatic mode of sorting is more frequently used by material recovery facility operators and plastic recycling facilities (Hopewell, Dvorak & Kosior, 2009).

After the sorting stage, the plastics are ground into flakes and then cleaned to get rid of any foreign material such as food particles and adhesives. In some cases, dry cleaning is used to remove any unwanted particles through friction. From this point, the sources of plastic waste in Accra will be discussed.

Plastic Recycling in South Africa

South Africa is one of the world leaders in the mechanical recycling of plastics. The plastic recycling industry is growing in South Africa and receives new entrants every month (Green Times, 2014). The industry is made up of about 221 recycling companies and an estimated 1800 converters who mostly operate on a small scale. Most of the plastics recycled in South Africa are used locally to manufacture new products in the packaging, building and industrial industry. In 2014, out of 315,600 tonnes of plastics that were diverted from landfill, about 90.2% was recycled locally while the remaining 9.85% was exported in order to be recycled. Also, the sector employed 47,420 people, representing an 11.4% growth as compared to 2013, with 6037 people engaged in the formal sector (WastePlan, 2014).

South Africa recycles 18% of all virgin plastics for further use (McKenzie, 2012). This is as against Australia's rate of 9.2% and Europe's rate of 14.2% (Green Times, 2014). According to Plastics South Africa, an organization which represents all sectors of the South African plastics industry, post-consumer use was the highest source of plastic waste in 2014 accounting for 63% of plastics recovered. The second highest source of waste was post – industrial sources, accounting for 14% of the plastics recovered. The four top plastics that are recycled are lower density - polyethylene (LD), high - density polyethylene (HD), polypropylene and polyethylene terephthalate (PET) (Plastics South Africa, 2015).

With respect to the recycling of PET, PETco there is an organization made up of PET resin bottlers, resin producers, brands that use PET in their processes and retailers of products made from PET. The aim of PETco is to minimize the disposal of PET in South Africa by supporting existing PET collection and recycling networks and promoting consumer

awareness on the importance of recycling PET (PETco, 2016). In terms of the future of plastic recycling in South Africa, the industry recently announced its Zero Plastic to Landfill objective by 2030 and is working towards achieving this goal (Green Times, 2014).

Plastic Recycling in Developing Countries

The recycling industry in developing countries has been described as young and informal due to the disregard for recycling and the ignorance of the potential value of waste materials (Troschinetz, 2005). Liebenberg builds on the works of Troschinetz by stating that as a result of the infancy of the recycling industry in Africa the compensation for recyclables fluctuates. Due to this the law of demand and supply plays here and different materials are recycled based on their buy-in price. He goes on to state that in many developing countries there is a limited market for recyclables and for international companies there is not enough supply of raw materials to establish plants in those areas. However, a few recycling plants can be found and buyers of recyclable material for export are located along some coastal cities with ports.

The act of collecting recyclable materials in developing countries is mainly carried out by the informal sector in an unorganized manner by people who by people who usually fall within the low-income brackets in their countries. Due to the large volume of plastic materials arriving at landfill sites informal salvaging also known as scavenging is widespread in Africa (Liebenberg, 2007). The types of plastics that are commonly recycled are polyethylene, polypropylene, polystyrene and polyvinyl chloride. The methods of collections vary from house – to – house collection of plastics, collection at a central point such as a market or church, collection from individual aggregators in exchange for money,

collection from shops and hotels, purchase from scavengers on a municipal dump or collection by oneself (Nkwachukwu, 2013).

A study carried out in twenty – three developing countries showed that municipal solid waste management personnel education, waste collection and segregation and government finances are the most significant barriers to recycling in developing countries. This implies that there is a lack of trained labourers and skilled professionals in municipal solid waste management, level of presence and efficiency of collection and segregation of waste and the lack of funding to municipal solid waste management by the government. Interestingly, household economics was the smallest barrier, showing that socio-economic status is not a barrier for recycling (Troschinetz, 2005).

Plastic Recycling in Ghana

According to a statement issued by the Environment Service Providers Association of Ghana, 510 tonnes of plastic waste is generated on a daily basis. Information from the Accra Plastic Waste Management Program shows that 120 metric tons of waste is recycled on a daily basis in Ghana, with empty plastic water sachets accounting for about 40% of this figure. Yet, most of the recycling companies operate on a small scale (Essel, 2015). The Accra Compost and Recycling Plant (ACARP) at Adjen Kotoku in Accra, one of the major recycling plants in Ghana is an integrated waste processing and recycling company that collects, sorts, processes, and recycles solid and liquid waste to produce organic compost for use in Ghana (Accra Compost and Recycling Plant, [ACARP], 2015). ACARP also produces pellets that are sold to plastic manufacturing companies who recycle the pellets into plastic products such as plastic chairs, tables and bowls (Essel, 2015).

About 10,000 youth are employed in the production of sachet water, plastic waste collection and recycling business sectors. A feasibility study carried out by the Centre for Scientific and Industrial Research (CSIR) showed that GHS1,200,000,000 (\$315,789,474) can be generated in the country every year if plastics go through the process of recycling. A research scientist of the CSIR stated that based on the findings of the study, 200 to 4,000 tonnes of plastic waste is expected to be produced in Ghana every month. This has the potential of generating substantial revenue for those engaged in the business.

Similar Studies on Topic of Study

In Troschinetz study on twenty – three developing countries he found twelve factors that influence sustainable recycling of municipal solid waste in developing countries. In this study, the countries involved were quantitatively and qualitatively examined in terms of municipal solid waste management. The outcome of the study was that the most significant barrier to sustainable recycling in developing countries are the education of municipal solid waste management personnel, the availability of waste collection and segregation services and the budget allocated by government to municipal solid waste management. This implies that there is a lack of trained labourers and skilled professionals in municipal solid waste management, level of presence and efficiency of collection and segregation of waste and the lack of funding to municipal solid waste management by the government (Troschinetz, 2005). However, Ghana was not a part of the twenty three countries that were involved in the study. Hence this study looks at plastic recycling in Accra, Ghana in order to understand the current situation and propose methods to improve upon it.

A study carried out by Owusu - Sekyere, Issaka and Abdul- Kadri shed light on some of the economic potentials that come about due to plastic waste collection and recycling in

order to establish wealth linkages drawing on the experiences of the Kumasi Metropolitan area of the Ashanti Region. Their study was carried out by visiting suburbs and other public spaces with the use of purposive sampling and simple random sampling. The conclusion of the study was that recycling is a profitable venture and that individuals depend on it for their livelihood. In order to strengthen this industry rules should be established in order to ensure that this industry is optimized (Owusu – Sekyere, Osumanu & Abdul – Kadri, 2013). This study goes on to build upon the works of Owusu – Sekyere et. al. by drawing lessons from other African countries in order to increase the wealth that is made in this industry.

Oteng – Ababio in his study on the private sector involvement in solid waste management in the Greater Accra Metropolitan Area in Ghana, stated that 2000 tonnes of refuse is generated daily. The AMA in its bid to manage this waste was left with a huge debt since 70% of the entire population of Accra enjoyed free waste-collection services. The aim of the paper was to examine the extent of improvement that a public - private partnership would contribute to solid waste management in the Greater Accra Metropolis area. Structured questionnaires were used to obtain the views of residents on solid waste management services through a public – private partnership. About twenty - five research localities were selected based on population density, income levels and the extent of physical planning. Within these localities 920 households were administered questionnaires through systematic random sampling.

The study demonstrated that there could be an overall, 25% improvement in refuse collection – as well as other areas such as waste recovery and recycling with the involvement of the private sector (Oteng – Ababio, 2010). In 2010, the Integrated Solid Waste Management Strategy was put in place to provide efficient and effective affordable

solid waste management services to Ghanaians. A local company, Zoomlion Ghana Limited became a partner in this effort in collecting waste. In this strategy the private sector was identified as a partner to provide services through privatization and public - private partnerships. This study differs from Oteng – Ababio’s study by concentrating on the lessons that plastic recycling companies in Ghana can learn from their counterparts in other African countries.

A similar study was carried out by Gugssa to analyze the structure and organization of the informal plastic and metal recovery system in Accra in order to bring about resource recovery. This was an exploratory study and hence made use of focus group discussions, observations, semi-structured interviews and questionnaires to collect data. The results of this study showed that the informal and metal recovery system is expanding due to unemployment and this sector is profitable (Gugssa, 2012). This study comes to the conclusion that the informal plastic recovery system is profitable. However, the plastic recycling industry remains relatively small. This study goes on to expose the challenges of companies in this industry and comes up with solutions drawn from the experiences of other African countries.

A study carried out by Wienaah had objectives to investigate the actual state of plastic waste management, the ways of handling plastic waste and to propose future sustainable waste management methods in Accra. The study concludes that although the collection and disposal of waste is the responsibility of municipal institutions they are unable to do this due to the rapidly increasing amount of waste. Due to this, recycling needs to be supported in order to improve upon its activities while effectively integrating it into the national solid

waste management system (Wienaah, 2007). This study goes on to reveal other challenges as well as propose other ways of improving the plastic recycling industry.

CHAPTER 3: METHODOLOGY

Objectives of Research

The objective of this paper is to describe the current state of recycling in Accra, identify the challenges that recycling companies are facing in terms of their supply of materials, technology and government support, and review how recycling is organized in a recycling company in South Africa to see lessons that can be drawn to improve upon the plastic recycling industry in Accra.

Research Questions

Based on the objectives stated above, the study seeks to answer the research questions below:

- What is the current state of plastic recycling in Accra? This includes the sources of supply for plastic recycling companies in Accra, the types of plastics they recycle, the technology currently used, the processes carried out and the final output produced.
- What are some of the challenges faced by plastic recycling companies in Accra in terms of their supply of materials, technology and government support?
- How have plastic recycling companies in other African countries succeeded in organizing their operations in order to provide wealth for themselves and their societies?
- What are the most important lessons that plastic recycling companies in Accra can learn from plastic recycling companies in South Africa in order to create more wealth for themselves as well as for the societies they operate within?

Type of Research

This is a qualitative research as it focuses on the processes and structural characteristics of the plastic recycling industry in a bid to capture the reality that exists in the field. A qualitative method of research is appropriate for this study because the main elements of qualitative methods include loosely planned designs that enable them to capture the reality as it plays out, the collection of detailed descriptions and presentation of data in the form of words and pictures (Sarantakos, 2005). As this study involves an understanding of the current state of plastic recycling in order to identify any challenges that exist as well as detailed descriptions, a qualitative method is the appropriate method.

Sources of Data

Both primary and secondary sources of data were used in carrying out this study. Primary data was collected from the recycling companies in order to understand the current state of recycling in Accra. The companies that were involved in the research include Accra Compost and Recycling Plant, Enviroplast Company, City Waste Management Limited, SkyPlast Enterprise and Blowplast Limited. Primary data was also collected from a plastic recycling company in South Africa, Transpaco Recycling, in order to learn about the processes that are carried out as well as the environment within which the industry thrives. Secondary data was obtained from journals and books in order to gain a deeper understanding of the recycling industry and to gain knowledge about how South African and Ghanaian plastic recycling companies operate in order to bring about maximum benefits to themselves and to their countries.

Sampling Strategy

The research was carried out in Accra, the capital city of the Greater Accra Region. A total of five plastic recycling companies in Ghana were included in the research and one in South Africa. These companies were chosen using the non – probability sampling strategy. Due to time constraints these companies were chosen to partake in the survey based on the level of expertise of the company as well as their availability. The managing directors of the companies listed above took part in the interviews and filled questionnaires in order to gather information for the research.

A similar sampling strategy was used by Owusu – Sekyere, Issaka and Abdul – Kadri in a bid to carry out an analysis of plastic waste collection and wealth linkages in Ghana. This strategy was beneficial as it makes it possible to explore the activities carried out in the plastic recycling industry in Accra.

Data Collection Tools

In order to achieve the objectives of this study, semi - structured interviews, open – ended questionnaires and sources on the internet were used to collect information. For the semi - structured interviews an interview guide was used to ensure that the relevant questions were asked in every interview. Semi – structured interviews were used to understand the activities carried out at the recycling companies as well as the challenges that they face in their operations. The internet was used to access books, published articles in journals and news articles to collect information on how plastic recycling companies in South Africa organize their activities.

Semi – structured interviews were used in order to ensure that at the end of each interview session data that was relevant to the study and based on the conceptual framework of the

study had been gathered. Semi - structured interviews make it possible to study and understand reality, allows respondents to express their views without limitation and permits findings to emerge and be analyzed during the interviewing process (Sarantakos, 2005). For the purposes of this study semi – structured interviews is the most efficient form of data collection as it allows data to be gathered on the current state of plastic recycling in Accra as well as on the challenges these companies face.

Questionnaires were used to gather information from companies whose managers could not be interviewed through face-to-face interviews. Open – ended questionnaires were used because they allow freedom for the respondents to provide detailed information, to offer information on areas that might have been unseen by the researcher and allow conclusions about the respondent's way of thinking (Sarantakos, 2005). In this research, open – ended interviews enabled managers to freely provide data on the operations of their companies as they were free pinned down to a rigid format.

Reliability

Testing the reliability of instruments is important as it ensures that the instruments of the research are not sensitive to the changes of the researcher or respondents. This also ensures that the research allows replicability and is objective, accurate, precise and consistent (Sarantakos, 2005). As this is a qualitative research, the processes carried out in this researched are explained in detail in order permit future researches to be carried out and similar findings gotten. However, it must be noted that changes that might occur within the plastic recycling industry may cause variations in the findings of studies carried out in the future that are employed by methods similar to this research (Sheton, 2004).

Method / Procedures

In order to successfully collect the needed information, research was carried out to identify the major recycling companies in Accra. Identifying these companies was a bit of a challenge as majority of the information about plastic recycling companies in Accra on the internet is inaccurate. As such, contact was made with other players within the waste management value chain in Accra such as waste collection companies as they deal directly with plastic recycling companies. Thus using the snowball approach, contact was made with plastic recycling companies in Accra in order to introduce the research to the companies and then a date was set to visit their site and carry out the interviews. Once the companies agreed to take part in the research an appointment was made to visit the recycling sites of the companies in order to collect the relevant information. In the course of the interviews, hand written notes were taken and these notes were typed out at the end of each day in order to ensure the safe – keeping of the data.

Simultaneously, contact was made with three plastic recycling companies in South Africa through the use of electronic mail in order to introduce and invite them to take part in the research. The companies that were contacted had operated in the plastic recycling industry for over fifteen years and hence had a vast amount of knowledge about the industry. One company agreed to take part in the research and after signing a consent form both parties arranged to use questionnaires as the mode of data collection. From then on, a questionnaire was sent to the company and once a response was received electronic mails were used to ask follow – up questions to which the company sent responses. In the course of contacting and gathering data from the Ghanaian and South African companies, the journals and new stories on the internet were used to collect information about the operation of the Ghanaian

and South African plastic recycling companies. The next section contains details on the data analysis methods used in the research.

Data Analysis

The qualitative data collected was analyzed primarily in a descriptive manner. From then, the data was analyzed using a combination of thematic analysis and summative content analysis. This was used in order to ensure that all the relevant data that was collected was retained and that the desired results were achieved at the end of the study (Sarantakos, 2005).

Once all the data had been collected it was read through once a day over a period of one week in order to adequately engage with the data and understand the plastic recycling industry. The data was then summarized using thematic analysis and summative content analysis. In the process of analyzing the data, more data was needed to fill some loopholes. The Ghanaian companies were contacted through phone calls and the South African companies through electronic mail. Based on the understanding gained the data was analyzed not only based on the themes that were established at the beginning of the research, but also based on the new themes that were identified in the process of analyzing the data. The results produced from the analysis are presented in the next section.

CHAPTER 4: RESULTS

This chapter is grouped into two main sections; the presentation of the findings and then the discussion of the results. The results will be reported in three sections; the current state of plastic recycling in Accra, the challenges faced by plastic recycling companies in terms of their supply of materials, technology and government support and plastic recycling as carried out by a South African company. These themes will be discussed based on the two major sectors that were identified as operating in the plastic recycling industry; the formal and informal sectors.

Presentation of Results

State of recycling companies

In this section the findings on the current state of plastic recycling in Accra will be presented by discussing the demographics of the companies, their sources of plastic waste, the different types of plastics that are recycled and not recycled in Accra, and the different stages that are involved in the plastic recycling process.

Although, the plastic recycling industry has been in operation for over two decades in Ghana most of the companies stated that the industry was still in its infant stages. According to them, the industry is mainly unstructured and unregulated. On the whole, there are neither any regulations that stipulate the manner in which plastic recycling should be carried out nor established authorities that plastic recycling companies have to report to.

Demographics of plastic recycling companies. Of the five Ghanaian companies that took part in the research all were registered as privately owned companies. The recycling companies have been in existence for a period ranging from four to eighteen years. These companies have employee strengths of between fifteen to seventy workers. Most of the companies have one branch from which they operate while one company operates from five branches. The research further showed that the plastic recycling industry can be divided into the formal and informal recycling sectors as shown in Figure 5.

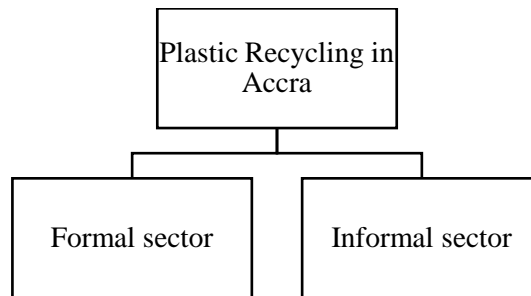


Figure 5. Plastic recycling industry in Accra

Formal sector. This research comprised four companies who are involved in the formal sector of the plastic recycling industry in Accra. This sector is made up of companies that have large capital investment and hence have large recycling facilities, and are situated in the industrial areas of Accra. It was relatively easy to find details about the major plastic recycling companies in the formal sector as their details can be found on the internet. The others were contacted through a snowball approach. These companies have been registered as privately owned companies.

Informal Sector. One of the companies that was involved in the research operates in the informal sector. The company in this category does not have as much capital as compared to those in the formal sector. Due to a limited amount of capital the companies' recycling plant is smaller as compared to those in the formal sector. Contact was made with this company through the snowball approach.

Sources of plastic waste for recycling

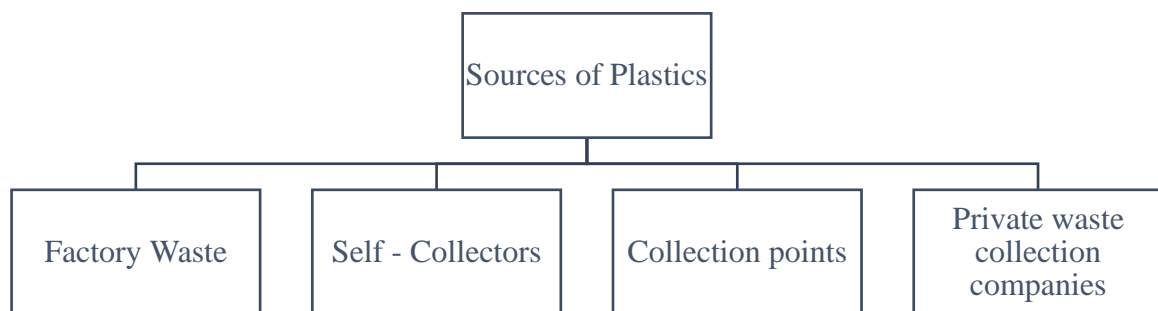


Figure 6. Sources of plastic waste for informal and formal sector

Formal sector. The main sources of waste for the companies which operate within the formal sector are individual collectors and private waste collection companies as shown in Figure 6. Some of the companies give individual collectors and factories monetary incentives for providing them with plastic waste. On the average, about 60 – 75 pesewas (15 – 18 cents) is given in exchange for one kilogram for used water sachet bags and other soft rubbers. It was gathered from companies that there is a difference in the volume and quality of plastics that is gotten from factories and those obtained through self -collection. Plastics gotten through factory waste are cleaner and are of larger volumes as compared to those gotten from individual collectors and from waste collection companies. Plastic

obtained from these sources are often not clean and hence have to be washed before they can be taken through the recycling process. These plastic recycling companies receive a total of about one tonne of waste plastic material daily from their suppliers.

Informal Sector. As shown in Figure 6, the sources of waste for the informal sector are mainly from factory waste and collection points with little coming in from individual collectors. The waste collected from these sources is clean to a large extent since most of the waste is from the factory. The companies pay between 40 – 60 pesewas (10 – 15 cents) for a kilogram of all types of plastic waste except polyethylene terephthalate (PET). About one tonne of plastic is collected per week by the companies.

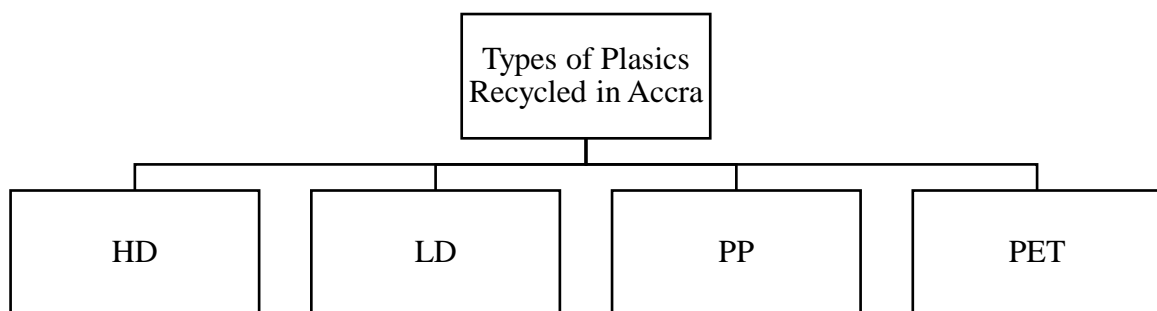


Figure 7. Types of plastics recycled in Accra

Types of Plastics Recycled. The interviews carried out proved that soft plastics in the form of polythene bags, sachet water bags, other soft plastic packaging and PET bottles are mainly the types of plastics that are recycled by both the formal and informal sector in Accra. Specifically, high density polyethylene (HD), low density polyethylene (LD), polystyrene (PS) and PET are collected as seen in Figure 7. From the companies that were interviewed the only person that collects PET bottles for the recycling process operates in

the informal sectors. The other types of plastics are recycled by a lot of companies and hence are traded for higher prices.

The Recycling Process

In this section, the plastics recycled in Accra will be discussed in two groups due to the difference in processes used in recycling them. The first group comprises of recycling HD, PE and PP plastics while the second group comprises of recycling PET plastics.

Recycling of HD, PE and PP Plastics

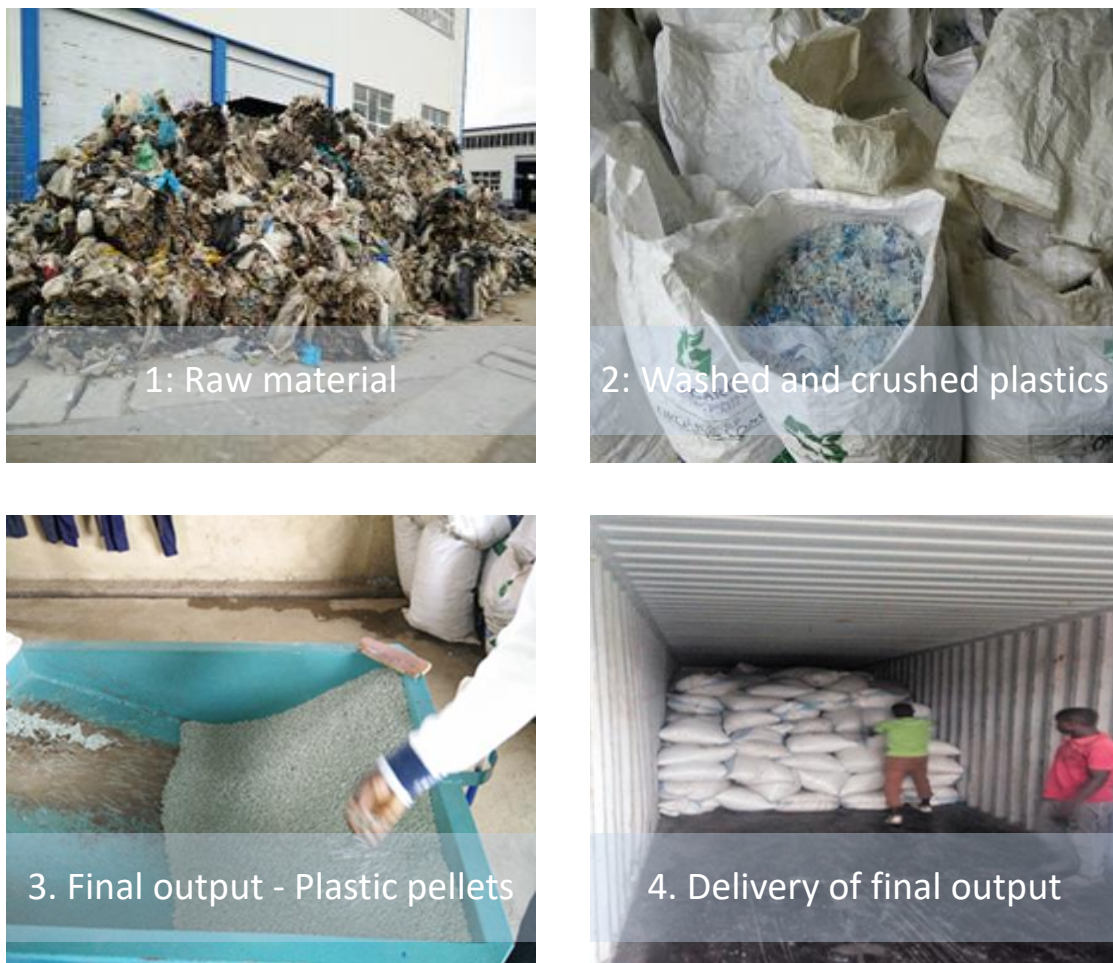


Figure 8. Transformation of HD, PE and PP plastics

In order to recycle plastic waste, plastic recycling companies go through a six-stage process of acquiring, sorting, washing, agglomeration, pelletizing and sale of plastic pellets as shown in Figure 9 below and the transformation process shown in Figure 8 above. For companies who source their plastics from factory waste they omit the washing stage as the plastics are already clean. One company crushes the plastics before washing them. Apart from these variations the process is similar for most of the companies. The acquisition stage is made up of the collection or weighing and buying of plastic waste. Once the plastic waste has been acquired it is temporarily stored within the recycling plants and then the next stage which is sorting is carried out. The plastic waste is separated into either HD or LD or PP and each type of plastic is processed differently. The separation of plastics is carried out both manually and mechanically. Once the sorting has been carried out the plastics are then put into machines in order to wash them to get rid of any impurities that are present in them.

The next stage of recycling is that the clean plastics undergo the process of agglomeration. Agglomeration is a process in which the plastics are heated until they reach melting point. Once the plastics are in a melting state the final stage of recycling process occurs. That is the pelletizing stage during which the plastics in a molten form are crushed into plastic pellets. Plastic pellets are the final product for some of the companies and these pellets are sold to plastic product manufacturing companies to be used in the production of plastic materials. Once the plastic pellets have been produced, a tonne of plastic pellets is sold for about GHS3000 (\$789). Some companies also export the plastic pellets to Europe and Asia. Also for some companies, the plastic pellets are not sold to other companies but are used in – house to produce black polythene bags of different sizes. The polyethylene bags

then become the final product which is sold to wholesalers for use in markets and grocery shops.

Taking into account a few inefficiencies on the part of the equipment used to recycle the plastics, about one tonne of recycled plastic is produced daily, with a few companies producing within four to five tonnes of recycled plastic daily. Apart from inefficiencies on the part of equipment, labour issues such as employees not showing up to work. The lack of constant supply of electricity also accounts for some of the inefficiencies that prevent plastic recycling companies from operating at their maximum capacity.

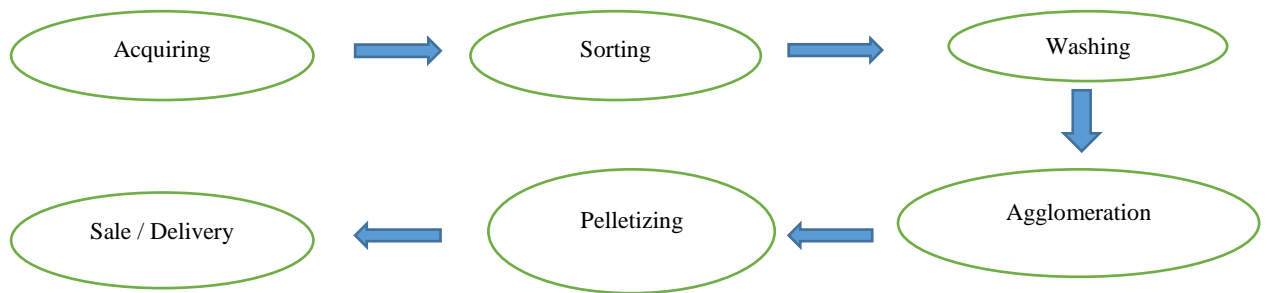


Figure 9. Stages of recycling HD, PE & PP plastics

Recycling PET plastics

Figure 10. Transformation Process of PET plastics

PET is a thermoplastic within the polyester family. It can be used for different purposes and is mostly used as a material for plastic bottles and other food containers (Huffing Post, 2011). One of the managing directors of the participating companies involved in the recycling of PET stated that the reason the PET bottles are not recycled is due to the lack of technology. The transformation of PET is shown in Figure 10 while the process that is carried out is shown in Figure 11. The recycling of PET like other plastics begins with the collection of the bottles. This is mainly acquired from factories and individual collectors however factories constitute the largest source of bottles. In the collection of PET about 30

pesewas (7 cents) is paid per kilogram of PET. Once the bottles have been acquired they are then crushed using a crushing machine.

Some of the factories from which the bottles are collected have a crushing machine that has been placed within the premises of the factory. Due to this waste PET bottles are crushed on the site of the company hence eliminating the collection stage of the process. Once the PET has been crushed it is packed into sacks for exportation. About thirty-five kilograms of the crushed PET goes into one sack. In the situation where the bottles are crushed on the site of a factory, they are bagged on the site of the factory and then transported to the site of the recycling company so that they are stored there until they are ready to be transported. The crushed PET is finally exported to China where it is used in the production of other materials.

It was noted that the company is arranging to acquire machines that have the ability to separate, crush and wash PET. The company is also interested in adding value to the PET instead of exporting it in its crushed state. This is because adding value to the crushed PET will increase its value so it can be sold at a higher price to increase revenue. He stated, “If value is added to PET no PET will be on the floor. Everyone will know that this on the floor is money and hence I will pick it up and sell.” The challenges faced by the companies will be discussed in the next section.

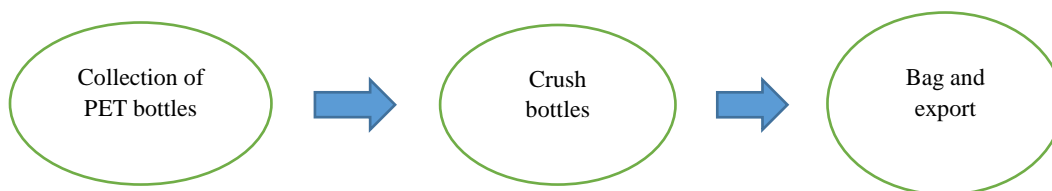


Figure 11: Stages of recycling PET

Challenges faced by plastic recycling companies

In this section the challenges that plastic recycling companies face specifically with regards to the supply of materials, technology and government support are discussed.

Supply of materials. Findings from the research showed that supply of plastic waste is not a major challenge encountered by plastic recycling companies when carrying out their processes. The companies stated that there is enough plastic waste available for the different recycling companies hence, the supply of materials is currently not a challenge. However, in some instances individual collectors seem to demand more monetary incentives in order to continue providing the companies with plastic waste.

Technology. It was gathered from the companies that an initial capital ranging from \$15,000 to \$30,000 is needed to start a plastic recycling company. The price variations are based on the level of quality and capacity that is required. The challenges that some of the companies face are the maintenance of machines due to power fluctuations and the low availability of specialized labour to operate the machine within the plant.

Government. The companies disclosed that currently they do not receive support of any form, from the government. In terms of legislation, there is no law that mandates citizens to recycle their plastic. Although there is a law that states that companies should ensure that their waste is well disposed of, this law is not enforced. As such, not all companies abide by this law and yet they are not being sanctioned for this.

Aside governmental support, there is no unified body, or organization/association for recycling companies. Due to this, they do not have a unified voice with which to communicate any concerns that they might want the government to know. Another

downside of not having an association is that they are unable to share knowledge and growth ideas. Currently the organizations into which the plastic recycling companies are grouped into are Ghana Plastic Manufacturers Association and the Environmental Services Providers Association but none of these is dedicated to plastic recycling.

Recycling of plastics in South Africa

In order to gather information about how plastic recycling is carried out in South Africa contact was made with a company that is well experienced with plastic recycling. The company which has been in operation for over twenty—two years has two branches and a total employee strength of over 200 workers.

Similar to plastic recycling companies in Accra the company acquires its plastic waste from aggregators, individual collectors and waste management companies. Incentives given to suppliers of plastic waste include competitive pricing for waste received, security of payment, continuous intake of supply due to the ability to handle large volumes of plastic waste, free training for suppliers on the identification and sorting of plastic waste and establishing long term relationships with suppliers through the use of dedicated sales and marketing executives in order to establish trust and loyalty with suppliers. Plastic waste is purchased for an average of ZAR 4.40 per kilogram (30 cents).

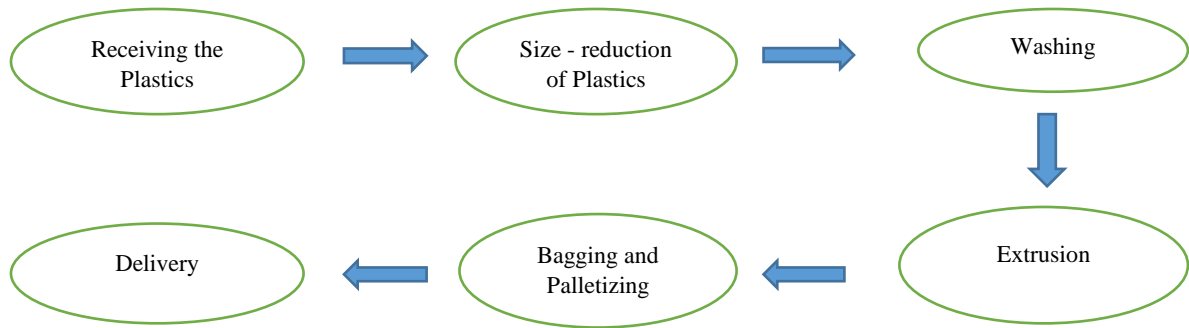


Figure 12. Recycling process of a South African plastic recycling company

The plastic recycling process of the South African recycling company is presented in a six stage process shown in Figure 12 above. This process includes receiving, size-reduction, washing, extrusion, bagging and pelletizing. Once the plastics are received they are sorted into different types, (HD, LD, LLDPE) and colours. The materials acquired are of different sizes and once sorted it is put into a shredder in order to get them into a uniform size. The shredded plastic is then fed into a washing plant where it is washed and dried in one process. From then, the plastics go into an extruder where they are melted and then eventually pelletized. The company produces a final output of about seventy – five tonnes daily. A tonne of plastic pellets is sold for about ZAR 11,000 (\$755). The final output that is produced, plastic pellets, is sold to building, agricultural, general packaging, piping, mining and automotive industries. The pellets are also exported to the Southern, Western, Central and Eastern parts of Africa.

In South Africa the Waste Management Act which was established by the Department of Environmental Affairs regulates the activities of recycling companies. Plastic recycling companies in South Africa are grouped into the South African Plastics Recycling Organization. This is a voluntary industry body with the aim of building a recycling industry that is respected and acknowledged by government, industry and the general

public. This is done by engaging stakeholders from government to private individuals in order to influence decisions on the importance of recycling. The organization also hosts workshops for members where information on the processing, equipment and product quality is shared. In addition, the organization gathers and publishes plastic recycling statistics and host competitions for best recycled products. There is no legislation in South Africa that mandates recycling in South Africa.

A challenge faced by the company in terms of the supply of materials is the lack of consistent supply of good quality raw materials. Another challenge is creating a wide spread network of suppliers and creating firm relationships with them. In terms of technology, the challenge faced is being able to acquire the latest technology and finding more efficient production processes accompanied by cost savings. The results presented above will be discussed in the section below.

Discussion and Analysis of Results

In this section, the findings presented above will be discussed in light of the existing literature stated in the second chapter.

Current State of Plastic Recycling in Accra

As stated in the literature review, the recycling industry in developing countries has been described as young. (Troschinetz, 2005). Information gathered from the research proved this to a large extent. Troschintez stated further that the reason for which the plastic recycling industry is young is due to the lack of respect for the value of recyclable materials. The study found out that the reason for which the plastic recycling industry is young is that it is unregulated. Although the industry has been in existence for over two decades in Ghana there are no regulations that govern the manner in which plastic recycling

should be carried out. It is however necessary that structures be placed in this industry as it is growing. This will ensure that a level baseline is set for all companies.

Types of plastics recycled. Nkwachukwu (2013) stated that the common types of plastics recycled in developing countries are polyethylene, polypropylene, polystyrene (PS) and polyvinyl chloride (PVC). The findings of the study show that PE, PP and PET are the types of plastics that are recycled in Accra. This is primarily due to the fact that the technology that is available in Accra can only recycle these types of plastics. However PS and PVC are found in car parts and pipes which are used in Accra and hence are also included in the plastic waste that is produced in Accra. This shows that apart from the plastics that are currently being recycled there is an opportunity to recycle PS and PVC in order to ensure that they are well disposed of and in order to make gains.

Process of recycling. Analyzing the plastic recycling process carried out in Accra and Guateng showed not much of a difference. The major difference between the companies in Accra and Guateng is that most of the companies in Accra wash their raw materials before shredding or crushing them while the company in Guateng shreds the plastics before washing them. The difference is mainly accounted for by the specifications of the machinery used by the companies such as the size of material that the washer can optimally function with. Also the sources of plastic waste for the companies in both cities are similar. However, in Accra, plastic waste is cheaper to purchase as compared to plastic waste acquired in Guateng. The difference in price might be due to the fact that there are more plastic recycling companies in South Africa as compared to Ghana. As such, plastic waste is in high demand in South Africa as compared to Ghana and this affects the price of plastic waste.

In Accra, a tonne of plastic pellets is sold for about \$789 while it is sold for \$750 by the recycling company in Guateng. The reason for the difference in price might also be due to fact that there are more recycling companies in South Africa as opposed to Ghana. This creates a high supply of plastic pellets in South Africa and which leads to lower prices. The opposite occurs in Ghana, where the few operational plastic recycling companies create a lower supply of plastic pellets as compared to those in South Africa. Hence the recycling companies in Accra command a higher price than those in Guateng.

It is interesting to note that the prices of the plastic pellets in Accra and Guateng are within a similar range. It is likely that the plastics pellets in both cities do not differ greatly. Hence the major difference between the companies in Accra and the company in Guateng is the technology available to them. The capacity of the machinery used in both cities affects their output and in effect the wealth that is created for the companies as well as the residents in their cities.

Challenges of Plastic Recycling Companies in Accra

Supply of materials. Liebenberg (2007) stated that the act of collecting recyclable materials in developing countries is mainly carried out by the informal sector in an unorganized manner by people who fall below the low – income levels in their country. From the findings of the research, the collection of plastic waste is not mainly carried out by the informal sector. Factory waste accounts for a substantial amount of the waste received by the companies. Also, the plastic recycling companies preferred plastic waste gotten from factories because they are gotten in large quantities and are cleaner as compared to those provided by individual collectors.

In terms of challenges faced with by the supply of materials, the companies that took part in the research stated that the supply of plastic waste is not a major challenge currently as there is an abundance of plastic waste in Accra. It was however noted that occasionally suppliers of waste demand more monetary incentives for the plastic waste. Yet this is not a major challenge.

Technology. Hopewell, Dvorak & Kosior (2009) as stated in the literature review above noted that there are four categories of plastic recycling through which the recycling process can occur. The findings of the research show that mechanical recycling is the type of recycling that is carried out in Accra. This is because the recycling process in Accra involves reprocessing plastics in order to produce plastics that have similar properties

One major challenge faced by the plastic recycling industry is raising capital to acquire machinery to operate in the industry. One of the companies stated that it can cost between one to seven million dollars to set up a plastic recycling plant that can recycle five tonnes of plastic daily. Also, it costs within \$10,000 - \$15,000 to acquire a PET crusher. The companies stated that most of their machinery is imported from China, India or Germany as the locally produced machines are of low quality. However, the different stages of the plastic recycling process provide different opportunities for investors to make gains from and to contribute towards a cleaner city. Investors can specialize and gain expertise in the different parts of the process such as the sorting, washing or crushing of the plastic waste. Through this expertise can be gained at the different stages while ensuring the total cost for entering into the industry is reduced.

Government. Based on the literature stated above, the lack of funding to municipal solid waste management by the government is among one of the three most significant barriers

to sustainable recycling in developing countries (Troschinetz, 2005). This is true in Accra as all the companies carrying out plastic recycling are privately owned and funded by the resources of individuals. As such, there is currently no funding from the Ghana government that is channeled towards plastic recycling. This discourages individuals from entering the industry.

The plastic recycling industry is capital intensive and hence the investment of the government in areas such as technology will increase the amount of plastic recycling carried out and also enable the government to save on the money spent on treating health issues such as malaria. Generally, an active recycling industry will also help to reduce the annual flooding problems Accra faces. As stated in the literature review, malaria costs the economy of Ghana \$735 million a year in the form of lost productivity within the corporate sector (Essabra – Mensah, 2015). Through the investment of the government in the plastic recycling industry in order to reduce the volume of plastics strewn around, the rate at which citizens of Ghana acquire malaria will decrease. The next section will summarize the research.

CHAPTER 5: CONCLUSION

Conclusion

In conclusion, the study set out to describe the current state of recycling in Accra, identify the challenges that recycling companies are facing in terms of their supply of materials, technology and government support, and review how recycling is organized in a recycling company in South Africa to see lessons that can be drawn to improve upon the plastic recycling industry in Accra.

The findings from the research showed that the plastic recycling industry in Accra is currently young and unstructured as stated by with companies operating in the formal and informal sectors of the industry. This finding proves the description made by Troschinetz in carrying out a study to identify twenty - three factors that influence sustainable recycling in developing countries. The type of recycling carried out in Accra is mechanical recycling and the types of plastics that are recycled are PE, PET and PP.

The two most significant challenges faced by plastic recycling companies in Accra based on the conceptual framework used in this study are technology and government support. With technology, acquiring the initial capital to purchase new machinery that will add value to the plastic pellets and crushed PET produced are the challenges faced. In terms of support for the industry, there is a lack of governmental support provided to both the formal and informal plastic recycling companies in terms of warehouse space and support to purchase advanced technology that will add value to the plastics once they go through the recycling process. It is important to note that there is not much difference in the process of recycling carried out by the companies in Accra and the company in Guateng. As such, the

level of technology used in both cities accounts greatly for the volume of output produced in both cities.

The findings of the research as stated in the introduction are of key importance to the government of Ghana and the Accra Metropolitan Assembly shows the actions that can be taken to support the plastic recycling industry in Accra in order to maximize the wealth that can be made within this industry. The next section presents some recommendations based on the findings of the research.

Recommendations

In this section, lessons are drawn from the plastic recycling industry in South Africa that can improve upon the industry in Accra. This will lead to a reduction in the amount of plastics littered in Accra, improving sanitation, and also enable recycle companies to profit from the wealth benefits of recycling larger quantities of plastics.

Supply of materials

Although recycling companies are not facing much of a challenge in this area they should consider improving upon their relationships with their suppliers in Accra. This is mainly because as the plastic recycling industry grows and develops a company's ability to get good quality plastics will become crucial to its operations. This can be done by training the suppliers and providing them with some of the tools used to collect plastic waste. This will also go to benefit the companies as the collectors will provide them with high quality materials which will improve upon the quality of their final product.

Technology

In order to increase the volume of plastics recycled, the recycling companies should engage stakeholders in government of Ghana as well as private individuals on the importance and relevance of plastic recycling to Ghana. This will assist them to raise capital to purchase advanced technology and also influence decisions concerning plastic recycling in Ghana. They should also consider entering into public – private partnerships in order to raise capital.

The companies should also consider visiting recycling plants in South Africa and perhaps more developed countries. Their exposure to more advanced and better established plants from around the world will guide them with regards to scalability and quality. This is an arrangement government can help with in order to make it possible to attend trade shows on suppliers of plastic recycling machinery in order to build relationships with equipment suppliers.

Government

To begin with, it is recommended that the government puts in place and enforces legislation that mandates companies that use plastics in packaging their products to ensure that the plastic packaging is not strewn around when customers are done consuming the product. This will make companies that use plastics to package their products responsible for the plastic waste created through their packaging.

The government must take steps to ensure that it regulates the activities of companies within the plastic recycling industry. This is in order to ensure that the activities that are carried out within this sector are legal and that plastic recycling companies comply with all the laws that companies in Ghana operate by. It is also important for the government to

regulate this sector in order to ensure that they pay tax so that the nation benefits from the revenue that is made within this sector. This tax can be channeled to support the recycling companies to carry out their processes through acquisition of equipment and technology and also providing warehouse space for startups in the industry.

The government should also establish partnerships with countries like Germany and India in order to purchase machinery for plastic recycling companies and give out to the companies on a hire – purchase agreement. Through such relationships, plastic recycling companies in Accra as well as in other parts of the country will get the opportunity not only to purchase plastic recycling machinery at good prices, but also to contribute to the reduction of plastic waste in Accra.

Creation of a Plastic Industry Association

Plastic recycling companies should consider creating an association for players in the industry. This will enable them to communicate with a unified voice on issues that are of concern to them. By forming a network they will also be able to build a strong reputation for the plastic recycling industry in Ghana.

Companies that use Plastics to Package their Products

Companies that use plastics in the packaging of their goods should also consider efficient ways in which they can retrieve their packaging from the environment. This is because when their branded packaging is strewn as litter all over it reflects badly on them. As stated by one of the managers, “They can put schemes in place that give customers a bottle of drink back when they return four empty bottles.” As Voltic Ghana Limited is currently doing, other companies can also place collection containers around town in order to make

it easy for customers to dispose of their empty bottles without harming the environment as shown in Figure 13 below.



Figure 13: PET collection containers of Voltic Ghana Limited

Limitations

To begin with, it was challenging to establish contact with plastic recycling companies in order to include them in the research. Apart from the major plastic recycling companies in Accra whose contacts were available on the internet most of the information on local plastic recycling companies on the internet was either inaccurate or outdated. Most of the companies listed as companies engaged in plastic recycling claimed they did not carry out plastic recycling when contacted. For others, the contact numbers that were listed could not be reached. As such, other players within the waste management system were contacted in order to get some leads on plastic recycling companies that could be involved in the

research. In the end a snowball approach, was used to contact plastic recycling companies in order to include them in the research.

Another limitation was that some of the companies were not willing to share information about their business. This was challenging as it made it difficult to obtain enough information in order to understand the current state of the plastic recycling industry in Accra. As such, the companies were told that their identities would be hidden and no private information about them would be published.

The use of one South African company as a measure for the plastic recycling companies in Accra is a limitation as a point of saturation may not be reached. However, the South African company has been in existence for twenty – two years and over period of existence has increased in the volume of plastics recycled daily from twenty – three tonnes per day within its first five years of operation to seventy – five tonnes per day currently. The company also has a wealth of information and experience that could be of benefit to plastic recycling companies in Accra.

The final limitation was of the plastic recycling company involved in the research, only one of them operates in the informal sector. However, the company has been in existence for ten years and is currently the only recycling company crushing PET in Accra. As such as the company has a lot of experience in the sector that can be leveraged on.

Areas for Further Research

In order to attain a further understanding of the plastic recycling industry in Accra and Ghana the health benefits of plastic recycling and the how the government may benefit from this should be carried out. This will be an effective way to prove to the government

of Ghana the benefits that they stand to gain if they invest in the plastic recycling industry in Accra.

The appropriate type of machinery that should be used for the recycling of plastics can also be researched on, so that the appropriate technology for the Ghanaian work climate is acquired. This will aid companies to know the best type of machinery to use in order to get optimal results in Ghana.

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APPENDICES

Interview Guide

Part 1

Demographics of Company

Name of the Company

.....

Number of years in existence.....

Number of Workers

Company infrastructure (privately held, franchise, publicly traded)

.....

Geographic Location

.....

Number of offices / branches

.....

Part 2

Interview Guide

Current State of Recycling in Accra

1. What are the various stages of plastic recycling in this company?
2. At what capacity is your company currently operating?
3. Who are the major competitors of the company?
4. How would you describe rivalry within the plastic recycling industry?
5. How much volume of waste does the company recycle weekly (input and output)?
6. At what rate has the volume of materials recycled changed over the past 3 years?
7. What is the quality of materials that are produced from your facility?

Challenges faced by Recycling Companies

8. In what ways does your company get materials for recycling? What are some of the challenges faced?
9. How would you describe the Ghanaians perception of recycling?
10. Is there any legislation that supports your work? In what way?
11. Is there any legislation that inhibits your work? In what way?
12. If government was to ban the use of plastics in Ghana what would that mean for the company?

13. Does change in technology pose challenges to your company in any way? In what way?
14. What systems and procedures would the company need to put in place in order to recycle all the plastic used in Accra?