

**MANAGING PLASTIC WASTE THROUGH REVERSE LOGISTICS IN SOME
SELECTED COMPANIES IN ACCRA**

KNUST

By

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DECLARATION

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person nor material which to a substantial extent has been accepted for the award of any other degree or diploma at Kwame Nkrumah University of Science and Technology, Kumasi or any other educational institution, except where due acknowledgment is made in the thesis.

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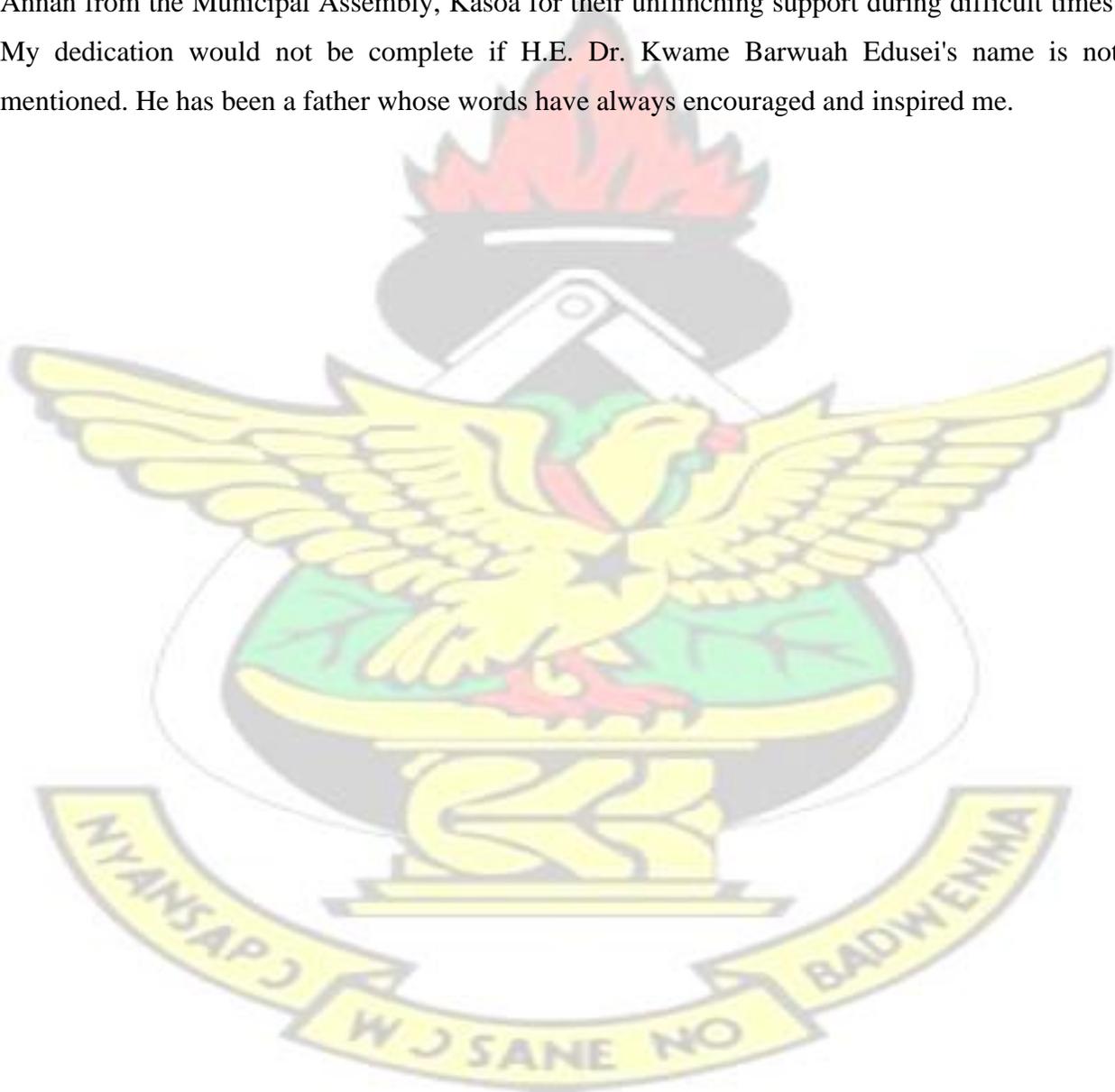
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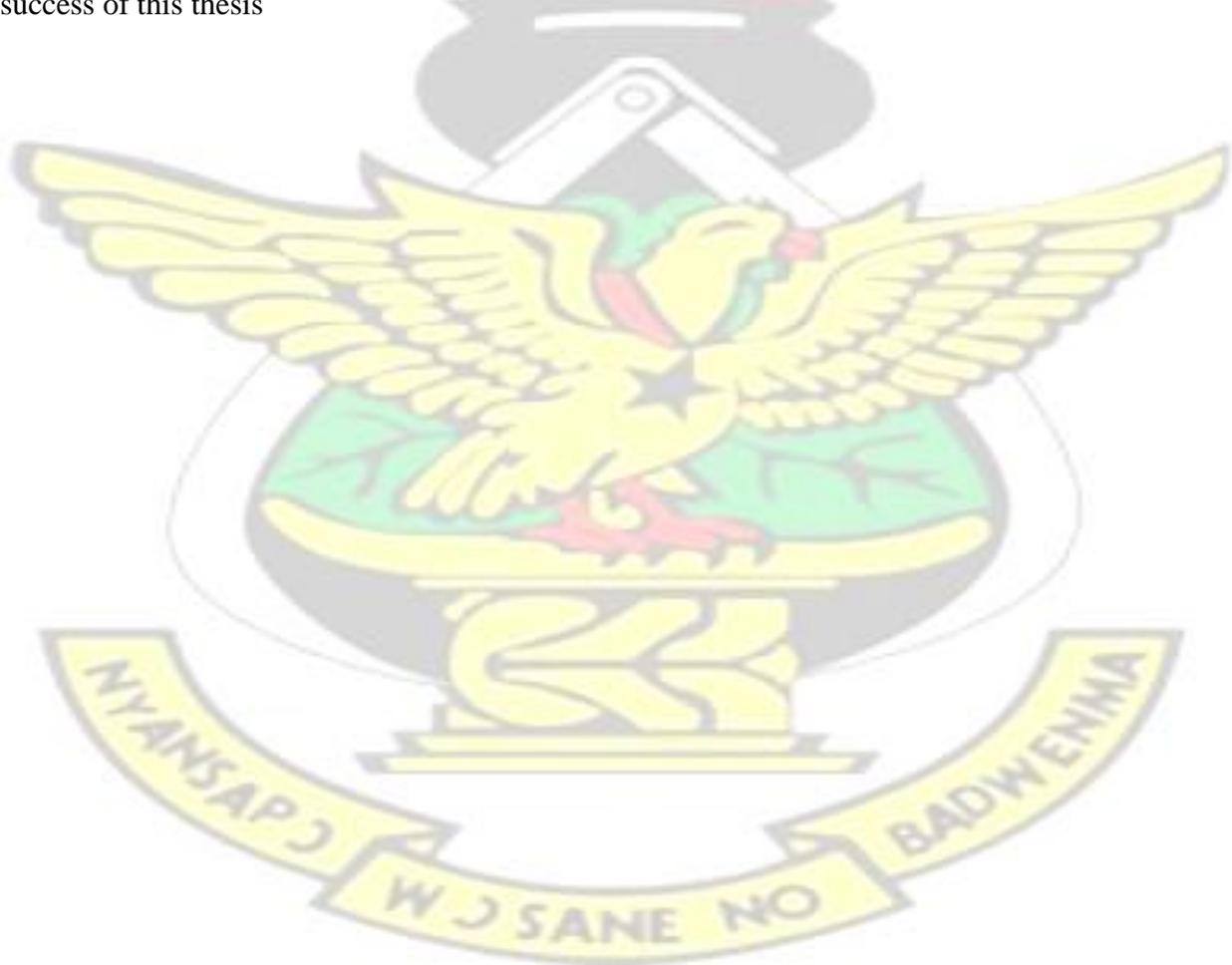
DEDICATION

I sought the face of the Lord, and he gave me insight, knowledge and understanding about this thesis. I therefore dedicate this thesis to the almighty God and also express my deepest appreciation to Dr. Listowel Owusu Appiah (KNUST) and my beloved family, especially my better half Mr. Isaac Kwabena Agyekum, for their spiritual and physical support. I take this opportunity to express my heartfelt gratitude to Mr. Stephen Yeboah from Jospong Group of Companies and Mr. John Annan from the Municipal Assembly, Kasoa for their unflinching support during difficult times. My dedication would not be complete if H.E. Dr. Kwame Barwuah Edusei's name is not mentioned. He has been a father whose words have always encouraged and inspired me.



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ABSTRACT

Proper waste management is critical to reducing plastic pollution. Plastic is a valuable and versatile material, but its improper disposal and mismanagement lead to harmful consequences for the environment. Effective management strategies are essential for environmental sustainability and to mitigate the effects of plastic pollution on our planet. Research has shown the importance of reverse logistics approach in the management of plastic waste. Despite its relevance, most stakeholders are yet to adopt this approach in the management of plastic waste. This study therefore focused on examining the management of plastic waste among companies that adopt reverse logistics in the supply chain in Ghana. Specifically, the study focused on the reverse logistics strategies of organizations' use of plastic bottles for product distribution and explored the role of supply chain members in plastic waste management; as well as examined key supply chain challenges in dealing with plastic waste management and evaluated the regulatory framework for dealing with plastic waste in the country. The study adopted the descriptive research design and qualitative study. The method of data collection used was non-probability sampling with the aid of interview guide. The study was analysed using the thematic approach. The outcome of the study suggests that plastic waste management through reverse logistics is an essential component of addressing the environmental challenges posed by plastic waste. It was also found that various stakeholders are involved in the supply chain process of plastic waste management. The result of the study revealed that there are regulatory frameworks governing plastic waste management, however, the quest to ensure the proper management of plastic waste is faced with challenges. The study therefore recommends that there should be the promotion of sustainable practices in reverse logistics, such as recycling, refurbishing, and reusing returned products and further research should focus on the role of public institutions in enforcing plastic waste management.

List of Abbreviations



UN	United Nations
EPA	Environmental Protection Agency
UNEP	United Nations Environmental Policy
MSW	Municipal Solid Waste
HW	Household Waste
PWMI	Plastic Waste Management Institute
RL	Reverse Logistics
SC	Supply Chain
PWCP	Plastic Waste Control Plan
SWM	Solid Waste Management
EOL	End of Life
ELV	End-of-Life Vehicles Directive
WEEED	Waste Electrical and Electronic Equipment Directive
RoHS	Restriction of Use of Certain Hazardous Substances Directive
OECD	Organization for Economic Cooperation and Development
EPR	Extended Product Responsibility
VMI	Vendor Managed Inventory

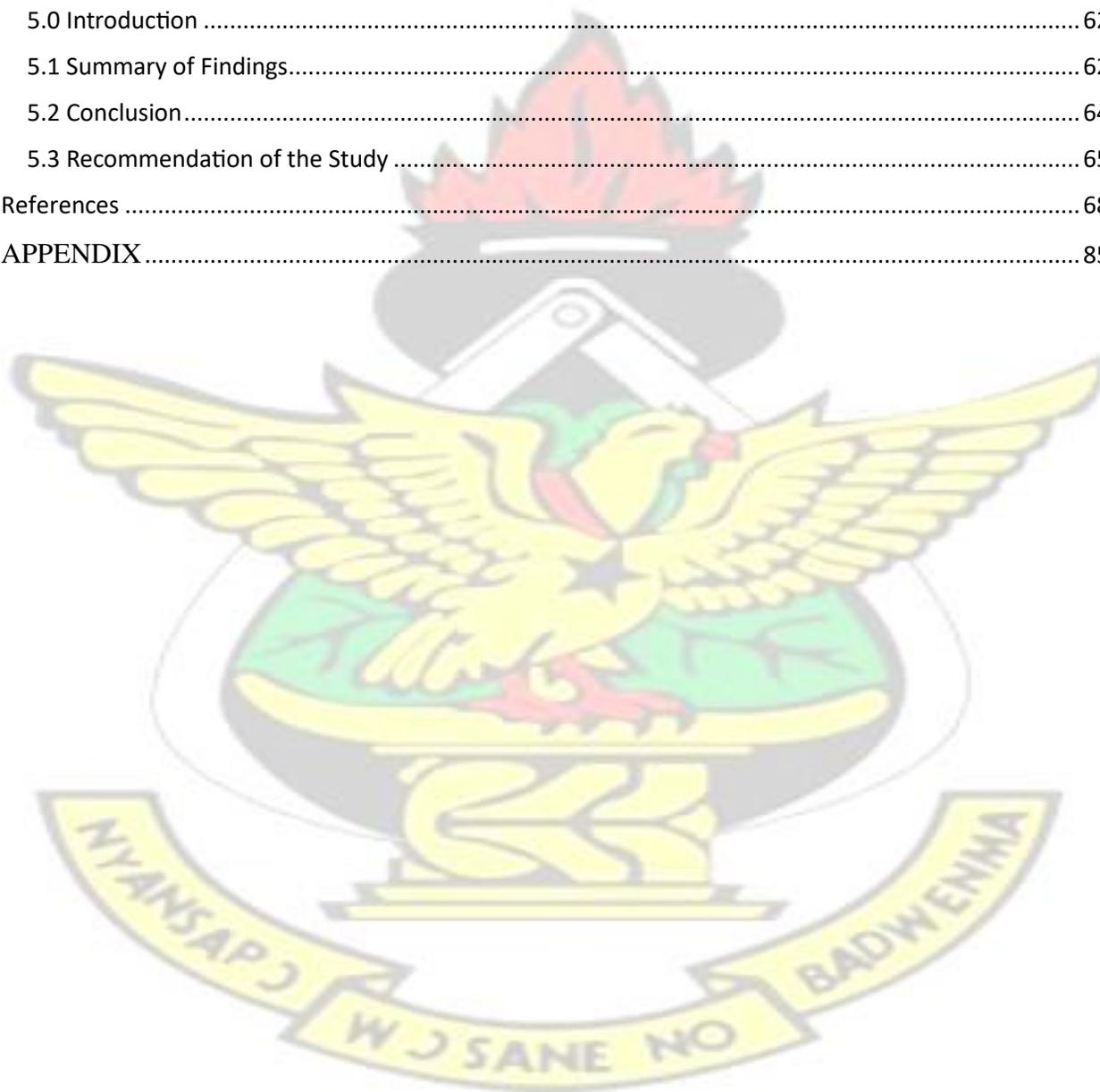
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CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

The need for having a sustainable system that meet the needs of the current generation without compromising the needs of the future generation cannot be overemphasized and it takes into account the role of all actors within a setting. It comprises stakeholders, businesses, policymakers, consumers, researchers, and the media (Hoballah & Averous, 2015). To achieve the ultimate circular loop with UN goal 12, responsible consumption and production more must be done with less. The goal is to improve quality of life by lowering resource usage from economic activities that would boost net welfare and reduce pollution across the entire lifetime. Several experts have brought forward the concept of the circular economy worldwide. In recent years, businesses and governments have shown increased interest in these topics (Geissdoerfer et al., 2017). Keeping all resources inside the economy in a circular fashion is one of the critical components of the circular economy. Materials from a product can be reused to provide more value once it serves their purpose no more (Di Maio et al., 2017). The ability to reuse, repair, and recycle things is one of several sectors' most essential actions right now. As a result, businesses worldwide are beginning to express interest in this economic model. However, there is still a need for further research on the circular economy, and future studies should concentrate on evaluation and indicators, particularly at the micro level (Elia et al., 2017). However, the goal of the circular economy is to reduce, moderate, and close energy leaks caused by resource input, waste, and emissions. This can be improved using durable design, reuse, remanufacturing, and recycling. The environment can benefit the present and future generations if appropriately managed (Geissdoerfer et al., 2017). Plastics are materials of high versatility in the industry, with applications in different sectors of the economy and growth prospects in the production of 4% per year until the year 2030 (Van Eygen et al., 2017). However, the plastic industry is facing several problems, such as the effects of climate change due to low degradability of these materials. Most often it takes between 100 to 1000 years, depending on the type of plastic, generating negative environmental impacts on the environment and the growing demands of customers towards the design of eco-efficient products (Environment, U.N., 2018). Worldwide, less than 10% of plastics are recycled, compared to 90% of metals. In

addition, the amount of plastic waste produced globally in 2019 was 353 million tons, more than doubling the amount produced in 2000 (Horodytska, 2019).

Ghana's usage of plastics affects a wide range of businesses and industries because it is essential to the purchasing and selling process (Teta et al., 2021). Regarding total volume, plastic packaging makes up around 26% of all plastics consumed (Drzyzga & Prieto, 2019). It is a popular option among customers and producers due to its lightweight capacity for storing food and its ability to shield it from contamination. In many areas of Ghana, there is inadequate infrastructure for waste disposal. Each year, Ghana imports around 2.58 million metric tons of raw plastic, of which 73% becomes waste. Only up to 5 percent of plastic waste is recycled; the remaining 95 percent ends up in landfills or the environment, with over 30 percent ending up in the ocean (Gameiro, 2019). The case of the city of Accra is relevant because for a number of years there has been extensive debate on how to improve a situation that can still be managed before it enters an emergency stage, where planning, and sustainable and efficient use of resources, are jeopardized. Data from the Ghana Health Service 2010 indicate that 60% of the most prevalent diseases are linked to insufficient environmental sanitation (Kanhai et al., 2021). To counteract the expected trend of significantly worsening environmental and population health in African cities, steps toward improving waste management need to be taken.

In an attempt to solve the menace of plastic waste, reverse logistics seeks to reduce the amount of energy and raw materials used by the plastics industry, which benefits environmental protection and sustainable development (Oliveira Neto et al., 2018). In light of this, reverse logistics has a significant role in creating a route for the distribution of green materials. Restructuring the supply chain to handle material returns is essential for effective waste disposal, recycling, and remanufacturing. Despite most stakeholders in developed nations starting to demand reverse logistics because of its importance to the economy and the environment, In Ghana, little effort has been made to ensure the accountability of businesses and customers to engage in the reverse logistics. Even though, Ghana, has policies (EPA, Plastic Waste Policy Company Law and Environmental Policy) on plastic waste management, the persistent of plastic waste in the country overwhelming with little effort coming from both the state authorities and individual stakeholders in resolving the menace. It is recognized that despite these policies, there no properly structured implementation plan to manage plastic waste and achieve sustainable development goal stipulated

by the UN convention. As such, this study tends to examine the plastic waste management through Reverse logistics strategies and how that approach aims to cut back on environmentally harmful activities in Ghana.

1.2 Problem Statement

The improper disposal of plastic waste has created numerous environmental risks in Ghana. A well-known example of how inappropriate rubbish disposal on land can have detrimental effects is the obstructing of gutters. In Accra, the well-known Asylum Down drain filled with enormous amounts of plastic waste which causes surface flooding during wet season leading to remarkable notorious floods which hit Ghana on June 3, 2015. (Yin et al., 2021). Additionally, clogged gutters cause stagnant water, which is a breeding ground for pests like mosquitos that transmit disease. The introduction of plastic waste into water bodies affects fishing operations.

The Ghanaian government has taken several steps to decrease the problem of improper plastic waste disposal and its effects. However the rules on disposing of plastic waste have a poor implementation (Teta et al., 2021). In 2019, the Ghanaian government paid off its debt to waste management providers in the region of \$200 million (Lissah et al., 2021). Furthermore, the improper disposal of plastic waste has resulted in several dump sites that obstruct the beauty of important regions of Ghana and take up a lot of space. The problem has lasted mainly because of how people think and how unfavorably they view managing plastic waste. Because of this, fewer waste management companies are currently operating, and environmental agencies operate differently. Laws requiring citizens to dispose of plastic waste in a controlled manner have not been upheld throughout time. As a result, many people litter without considering the consequences or risking punishment. The government cannot forbid plastics since there is no policy.

The country's most prevalent and earliest methods of managing plastic waste are landfilling and burning, neither sustainable nor favorable to the environment (Agyeman et al., 2019). Different structures and approaches have been developed to address the issue of plastic waste globally, specifically in Ghana (Asare et al., 2019; Debrah et al., 2021; Tulashie et al., 2020). The Pokuase plastic waste recycling program was one of the first projects in Ghana. The program's success in removing plastic from the environment has barely been noticed. This is because, despite the implemented recycling program, the amount of plastic waste in Ghana's urban environment keeps growing every year.

There are two possible causes for this: either the recycling plant's capacity is insufficient to handle the volume of plastics being produced, or there is no plastic waste collection program that is viable enough to remove plastics from the system and feed the recycling plant. Some people contend that Accra needs new plastic waste recycling facilities to supplement the existing ones at Pokuase. But given worries that even the Pokuase facility is not being used to its full potential, the country's limits in managing plastic waste may be pointing to the absence of sustainable plastic waste collection in the nation (Fobil & Hogarh, 2016). Another important tactic is a community-based approach to plastic waste management that divides duties among homes, local government agencies, and plastics manufacturers.

A more significant fraction of the plastic waste, typically at dump sites, can be collected efficiently and at a reasonable cost by promoting producer accountability and family participation. The program aims to operationalize a multi-stakeholder return and buyback system that will make it easier to collect and return waste that typically ends up in our environment for recycling (Quartey et al., 2015). According to Quartey et al. (2015), managing items at the end of their useful lives in the supply chain and producer accountability could result in sustainable solid waste management. Many authors have examined the management of plastic waste in Ghana and other countries in the Sub-Saharan.

According to Tulashie et al. (2019), fuel can be produced from the pyrolysis of mixed plastic wastes for various uses. In addition, Asare et al. (2019) suggested that plastic waste might be managed by being included in plastic roadways as a component of the asphalt used to build roads in Ghana. Agyeman et al. (2019) and Tulashie et al. (2020) argued in a related study that it is conceivable to turn plastic waste into pavement blocks, which can help slow the rapid buildup of plastic waste in Ghana. However, little research has been done on how Ghana's plastic waste can be managed using reverse logistics. More importantly, little is known about how businesses implement this sustainable strategic effort and what motivates them. Reverse logistics is being implemented slowly by Ghanaian businesses despite how beneficial it is to their supply chains. On this premises, the research fully focused on examining the management of plastic waste among companies through reverse logistics.

1.3 Research Questions

To address the core challenges of the research in mind, questions were formulated to guide the research. These include:

- Which reverse logistics strategies exist in the use of plastic bottles for product distribution in organizations?
- How supply chain members affect plastic waste management?
- What are the challenges in dealing with plastic waste management?
- Which regulatory framework exist in dealing with plastic waste in the country?

1.4 Objectives of the Study

1.4.1 Main objective

The main goal of the research is to examine the management of plastic waste among companies that adopt reverse logistics in the supply chain in Ghana.

1.4.2 Specific objectives

The study intends to achieve the following specific objectives:

- To examine the reverse logistics strategies of organizations' use of plastic bottles for product distribution.
- To explore the role of supply chain members in plastic waste management.
- To explore key supply chain challenges in dealing with plastic waste management.
- To explore the regulatory framework for dealing with plastic waste in the country

1.5 Significance of the Study

The results of this will contribute to the body of knowledge in reverse logistics operations and identifies research gaps to be considered in the future. A general reverse logistics for plastic waste management is modelled using selected companies in Ghana. The design will assist third party stakeholders or government to take and develop reverse logistics programs and policies, this will contribute to the country's economy and to create a sustainable environment. This will create and opportunity of substitution of raw materials with the value-added waste products through collection and recycling process. Again, it will make a considerable impact among Ghanaian firms to collect their plastic waste and control their recovery or disposal. Besides, it will create a way for both academicians and industries to do further research, and develop reverse logistics programs.

Furthermore, researchers, policy makers, consultants and academicians will benefit from the research output as a source of reference.

1.6. Scope of the Study

The study includes firms that are into the management of plastic waste using the reverse logistics framework in Ghana. This involves manufacturers and retailers that deal with plastics along the supply chain. Management and subordinates of firms are the key target respondents of this study.

1.7 Operational Definitions

Reverse logistics: it refers to the supply chain process of returning products from end users back through the supply chain to either the retailer or manufacturer.

Supply chain: is the entire system of producing and delivering a product or service, from sourcing the raw materials to the final delivery of the product or service to end users.

Waste disposal: it is removing, discarding, recycling or destroying unwanted materials called waste that is produced from agriculture, domestic or industrial products.

Recycling of waste: is any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes.

Plastic waste: is the accumulation of plastic objects (e.g., plastic bottles and much more) in the environment

1.8 Research Methodology

The research approach was more deductive. The research plan was qualitative study. The key informant, which comprised of top-level management were engaged to ascertain the key issues relating to the research objectives through a qualitative approach.

In all, four organisations with a total of twelve participants were selected for the personal interview. They were basically including managers of the firms. These were selected from the following functions or department, purchasing, logistics, stores, production, marketing and sales.

1.9 Organization of Chapters

The research is divided into five sections. The backdrop of the study, the problem statement, the study's objectives, the study's importance, the study's scope, and the operational definitions are all covered in the first chapter. The literature relevant to the topic is presented in the second chapter.

In chapter three, the methods and procedures employed to achieve the study's goals are discussed. The results and discussion are presented in chapter four, and the study's summary of findings, conclusions, and suggestions are presented in chapter five.

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CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

Worldwide issues with waste exist and can be a nuisance or a resource. Significant harm is done to the environment, the economy, and society as a whole by solid waste. Waste may harm communities and the planet if it is not appropriately controlled (Johansson, 2016). Waste has been defined as unwanted and useless resources as well as outdated or obsolete components (Das, 2021). Waste is a rising problem that is strongly attributable to how humanity creates and consumes, and if it is not effectively managed, it poses a real threat to both the environment and human health (UNEP, 2015). The waste type classified as solid waste, which is also referred to as waste in the US, refuse or rubbish in the UK, is made up of the materials we use but dispose on a daily basis (*Solid Waste Management 1*, n.d.). Among other inorganic wastes from household, commercial, institutional, and anthropogenic sources, it mostly consists of bio-waste, yard wastes, receptacles and packaging material (*Solid Waste Management 1*, n.d.).

Municipal solid waste (MSW), one of the primary by-products of an urban lifestyle, is growing in bulk even faster than the pace at which the modern society is becoming more urbanized (Hannan et al., 2015). One of the outcomes of human activity is MSW, and as the city population and urbanization grow, the amount and complexity of MSW that must be controlled quickly rises (Elagroudy, 2016). Urban household solid waste is rising quickly in many nations throughout the world due to economic growth and higher living standards for citizens (Meng et al., 2019). A significant portion of municipal solid waste is made up of household waste (HW) (MSW) (Suthar & Singh, 2015).

On the other hand, industrialization has also led to significant issues with environmental contamination (Ipieca et al., 2015). Waste produced by industrial processes like manufacturing, fabrication, construction, chemical plants, and other processes is referred to as industrial waste (Menbere, 2019). Industrial wastes are inherently dangerous, and if inadequately managed, they could represent a risk to both human health and the environment (Olajumoke & Oluwagbemiga, 2017). Any kind of solid waste produced by an industrial process is referred to as industrial solid waste. In addition to inorganic components like scrap metal, plastic, and building debris, it may

also contain organic substances like wood, cardboard, or paper (Ingenium, 2022). According to PWMI, 2019, Industrial waste is waste released as a result of operations in factories, farms, construction sites, and other places where businesses are conducted.

Agricultural wastes are described as the byproducts of the production and processing of agricultural goods, including fruits, vegetables, meat, poultry, dairy, and crops (Obi et al., 2016). These wastes are the leftovers from the production and processing of agricultural goods, and while they may include substances that are beneficial to people, their economic worth might not match the expense of collecting, transportation, and processing (Paul et al., 2019). Almost all agricultural operations produce waste, which is produced in considerable amounts in many regions however, treating these wastes can cause significant financial loss and environmental degradation that poses a major threat to human health (Mokhena et al., 2016).

Industrialists and academics are becoming more interested in reverse logistics as a result of the massive waste creation that is causing growing environmental discomfort (Prajapati et al., 2019). Due to regulation, corporate social obligation, escalating environmental issues, and sustained level of competition, reverse logistics (RL) has recently gained relevance for all enterprises (Agrawal et al., 2015). According to Agrawal et al., (2015), the term "Reverse Logistics" involves a series of steps necessary to collect old products from clients for reuse, repair, remanufacturing, recycling, or disposal. According to its definition, it is the "sequence of operations designed to collect the old product from the consumers for their disposal to either reuse, repair, re-manufacture, recycle, or dispose of it (Agrawal & Singh, 2019)." Reverse logistics refers to a set of activities carried out inside a supply chain that include product returns from downstream participants to the upstream, product reprocessing, and product remanufacturing (Guo et al., 2017).

Reverse logistics, in its most basic forms, begins with individual consumers (first customers), where used products are accumulated from clients (return products). Thereafter, efforts are made to control End of life products via decisions such as recycling (to have more raw materials or raw parts), remanufacturing (to resell them to second markets or, if possible, to first customers), fixing (to sell in the second markets via maintenance), and, lastly, getting rid of any used goods (Govindan et al., 2015). Reverse logistics are crucial to the integration and use of circular economy

principles in supply chains, and they have attracted a lot of attention in recent years owing to their focus on sustainability (Agrawal & Singh, 2019).

The difficulty faced by RL (Reverse Logistic) networks is mostly brought on by the greater supply unpredictability that makes these systems more complex than conventional forward logistics networks (Alshamsi & Diabat, 2015). Also, according to Alshamsi & Diabat (2015), the high costs of transportation, prospective facility locations, and other considerations, investors run a considerable risk when making judgments during the reverse production design stage. Industries are eager to include Reverse Logistics activities into their operations, but they also face obstacles including a lack of resources and experience for doing so (Mangla et al., 2016).

2.1.1 Procedures in Management of Waste through Reverse Logistics

Standard logistics operations include procedures used by an organization to collect worn, damaged, undesirable (stock balancing returns), or outdated product lines, as well as production and shipping materials, from the end-user or supplier (Abdissa et al., 2022). When a product enters an organization, there are several disposal choices to think about, such as the following as known as RL process operations as stated by Abdissa et al. (2022). According to Sangwan (2017), there are three key activities when it comes to reverse logistics, they are collection, inspection and sorting, and product recovery.

Collection: Many users of plastic items discontinue their use before it is too late. Due to lack of knowledge, these clients frequently regard the worn item like waste which makes governments, societies, and prospective manufacturers concerned about the economic, social, and environmental issues caused by this circumstance (Alkahtani et al., 2021). According to Jindal & Sangwan (2015), determining the economic sustainability of the overall recovery effort depends on the collecting operations. Therefore, recovering returned goods calls for an effective and efficient collecting strategy (Jindal & Sangwan, 2015). Jindal & Sangwan (2015) further stated that the actual recovery process activities may be economically viable but the entire business is not, due to collection costs. Product collection from consumers, inspection, and transportation of the product back to the recovery systems such as remanufacturing, recycling, repairing, or reuse combine to make up the collecting activity (Alkahtani et al., 2021). To complement the collecting mechanism, several economic and legislative measures have also been introduced (Alkahtani et al., 2021).

Inspection and sorting: This method, in general, has the same purpose as Sorting, which is the specification of the suitable destination for the returning product (William et al., 2022). The items are examined and categorized after collecting. Inspection and sorting consists of procedures that decide if a particular product is reusable or not, and if yes, then to what degree (Sangwan, 2017). According to Sangwan (2017), the technology lowers transportation expenses by identifying scrap early and shipping it to a waste disposal facility. However, testing practices must be dependable and uniform throughout all locations.

Product recovery: Recovery of resources is not always profitable for the economy as companies can use a variety of policy measures to help achieve their goals in these circumstances (Sangwan, 2017). Repair, reuse, refurbishment, remanufacture, cannibalization, recycling, and disposal are a few of the product recovery techniques (Sangwan, 2017). According to Sangwan (2017), Remanufacturing a product is done to make it "as new" by performing the required disassembly, overhaul, and replacement procedures to get value-added recovery rather than merely materials recovery. Due to the high level of unpredictability, high uncertainty, and consequent complexity that reverse logistics and remanufacturing operations must cope with, remanufacturing is a frequently underappreciated value recovery process (Karvonen et al., 2017). Remanufacturing, repairing and recycling are all phases in product recovery.

2.2 Research Conceptualisation

2.2.1 Recycling

Recycling is a process that transforms solid waste into new goods to avoid the waste of potentially useful materials, reduce the consumption of fresh raw materials, use less energy, reduce air pollution (from incineration), and water pollution by reducing the need for "conventional" waste disposal as recycling also emits fewer greenhouse gases than the production of plastic (Banerjee, 2015). Recycling is the practice of reusing undesired or waste resources in the manufacturing of new goods (Mwanza, 2021). Recycling is thought to be the most efficient way to protect the environment on Earth by simply reusing the products rather than throwing them away, we can minimize waste production and maintain natural resources for the future (Beardsley, 2021). Sustainable methods of management are needed since municipal solid waste management is one of the most underdeveloped areas of urban development (Mwanza & Mbohwa, 2017a). Now that

waste is being viewed as a resource that could be used again in production lines or industrial processes, it is no longer considered to be waste (Oke & Kruijsen, 2016).

Recycling is a continuing phenomenon that extends a material's life cycle (Master Recycler Program, 2020). To find potential for reusing solid waste materials or components, recycling necessitates a review of waste streams and industrial processes (Waste et al., n.d.). The first step of recycling is collection of materials, the collected materials are then processed and marketed, and these materials are now converted into new products which are later sold to consumers as new products. Secondary raw materials are those that are obtained from primary raw materials that have already been used and are then gathered, sorted, and processed to create new raw materials and components (through recycling) (Verrips et al., 2019). Recycling in modern contexts is essential if we really want to experience the future on our planet. Communities all over the world are urged to stay in the recycling loop since it reduces waste and CO₂ emissions, saves energy and raw materials, and benefits the environment (Freestone, 2017).

2.2.2 Reverse logistics and recycling

The primary factors contributing to increasing solid waste creation include industrialization, population growth, urbanization, and economic expansion (Tefaye & Kitaw, 2021). Tefaye & Kitaw, (2021) stated that Reverse logistics (RL) is a fundamental tenet of a circular economy that is crucial to the movement of materials, products, and data from end consumers to original producers or other routes. Reverse logistics plays an important role in recycling. The difference between reverse logistics and waste management is that it includes value-adding operations including testing, sorting, repairing, recycling, and redistribution of items (Macarthur Ellen, 2015; Mehmet, A. and Gu'l, 2016).

Post-consumer recycling's essential procedures include collecting, classifying, cleaning, reducing in size, and separating plastics as stated by Tefaye & Kitaw (2021). Recycling items are removed from general rubbish and routed via the collection process to a processing plant. Curbside, drop-off centers, buy-back centers, and deposit refunds are all used for collecting (Tefaye & Kitaw, 2021). Customers put plastics in curbside containers so they may be picked up with other solid debris. Customers take plastics to nearby collection points from the drop-off location. Consumers get rewards at the buyback facility, which also serves as a location for deposit refunds, tax refunds on product use, and the return of plastics for recycling (Mwanza et al., 2018).

2.2.3 The reverse logistics strategies of organizations

The support for circular economy through reverse logistics is transforming the traditional linear approach of moving materials to a closed-loop system that focuses on the flow of products and materials. Utilizing reverse logistics can assist businesses in reducing waste by implementing strategies like reusing, recycling, and repurposing returned materials, and can also help create a positive public image (Van Seters and Richard 1990). To effectively manage returned products, businesses must identify suitable locations for processing, such as assembly, delivery, and refabrication lines. Various reverse logistics activities, such as direct reuse, repair, refurbishment, remanufacturing, recycling, incineration, and landfilling, are used to handle different types of returned products (Van Wassenhove 1995). However, waste disposal through incineration and landfilling is only considered when the returned product provides no value to the organization. Therefore, waste disposal with energy recovery is preferred, as it minimizes the amount of waste sent to landfills by utilizing the calorific content of the waste to generate energy. Additionally, incineration can lead to economic benefits if the energy produced is utilized for other purposes.

Reverse logistics primarily focuses on reusing products for a similar purpose, which is considered to be the primary activity of this process. Seles et al. (2016) explained that reusing involves salvaging any part of the product returned to the organization, which still holds some value. Reuse also involves cleaning, repairing, and refurbishing used products, as well as recovering functional packaging materials (Bula, 2015). Reuse is the most environmentally friendly waste management practice among all reverse logistics systems (Amemba, 2021).

Recent research (Okwu et al., 2021; Fikru, 2020; Ebenezer and Sun, 2019; Banadda et al., 2019) indicates that the distribution of bottled water packaged in plastic containers to both local and international markets in Ethiopia is increasing rapidly, as people prefer it over tap water. However, environmental experts and the country's environmental regulations have raised concerns about the sustainability of this practice, as plastic water packaging is not environmentally friendly. Therefore, Ethiopian companies producing bottled water could consider recycling or reusing the plastic packaging through reverse logistics by collecting them from end-users since they take hundreds of years to decompose (Matiwos, 2014).

Seboka (2011) suggests that there are various methods of managing plastic in the natural environment, such as landfilling, recycling, and incineration. However, according to Matiwos'

(2014) research on the disposal of used water bottles in Addis Ababa, Ethiopia, only a small percentage (3.5%) of plastic bottles are returned for recycling, while the majority are either thrown in the waste (35.9%), reused (37.3%), or disposed of indiscriminately (23.2%). Ethiopia faces several challenges in effectively managing solid waste, including financial constraints and a lack of experience in waste reduction, waste recycling, energy options, waste separation, and composition (European Parliament and Council, 2008).

2.2.4 Reverse Logistics Strategies and Other Industries

Different industries use various reverse logistic (RL) strategies for different purposes. This study's RL strategies were identified by reviewing literature, including studies by Chiang et al. 2021, Montemayor and Façade 2020, Rose et al. 2020, and others. Chiang et al. (2021) focused on the iron and steel industry in China, and used a multi-criteria decision-making method to evaluate the dependence and feedback among decision factors. The authors proposed three RL construction strategies - self-operation, joint-venture, and outsourcing - based on a review of the literature and in-depth interviews with experts and decision-makers in the steel industry. According to their findings, the self-operation strategy is the most suitable for constructing RL in China's iron and steel industry, considering the current state of the environment.

Reeves (2019) conducted a study to investigate how to manage risk and minimize disruptions in the supply chain (SC) of food and beverages. This study was motivated by the significant challenges that SC managers in this industry face when trying to use effective strategies to reduce disruptions, costs, and risks. Reeves identified communication, inspection, and cost allocation as potential strategies that SC managers can use to mitigate risks within the SC. The author suggested that SC leaders could apply the study's findings by implementing a thorough inspection strategy to prevent damage to goods and improve communication with partners, and also by using cost allocation strategies to minimize financial losses resulting from returning spoiled or damaged products to the original source.

According to the Montemayor Façade (2020), there are several RL strategies that can help achieve circularity for curtain walls and window façade constructions. These strategies include recycling, reusing, energy recovery, repair, remanufacture, maintenance, refurbish, and redistribution. The author believes that there is a need to create a framework for the development of RL strategies with the help of appropriate stakeholders. To facilitate this process, the author conducted an

investigation of the existing literature and circumstances surrounding curtain walls and window façade constructions, which led to the proposed RL strategies.

Pushpamali, Agdas, and Rose (2021) also addressed knowledge gaps related to the environmental impact of RL strategies from a construction SC perspective. They employed recycling, reusing, landfilling, and remanufacturing as RL strategies to recover material value and reduce the social and environmental burden of the industry. Their results showed that "reuse" had the least environmental impact, followed by remanufacturing, recycling, and landfilling, which was the least environmentally friendly end-of-life option. The RL strategies proposed by Rose et al. (2020) are similar to those of Montemayor Façade (2020), but they differ from those mentioned by Reeves (2018) and Chiang et al. (2021).

2.2.5 Advantages of reverse logistics

With an ecological perspective on the advantages, reverse logistics encourages alternate resource uses that may be both economical and ecologically benign by extending the product life cycle (Grabara et al., 2014). Businesses as well as consumers are prepared to pay extra for items that don't hurt the environment (Grabara et al., 2014).

Saving money is reverse logistics' primary goal (to minimize costs and increase profits), Reverse logistics ensures that affordable replacement materials will be used in lieu of the originals, conserving natural resources, labor, and energy (Fikru, 2020). According to Grabara et al. (2014) Reverse logistics offers the chance to increase the value of the returned item via the use of repair, reuse, and recovery techniques.

The environment is seriously threatened by the existence of poisonous hazardous compounds including lead, mercury, polybrominated ether, and hexavalent chromium in old electrical components (Chiang et al. 2021). Twenty-nine states in the United States still have a 10-year landfill capacity, fifteen have five to ten years, and the remaining six have less than five years (Pushpamali, Agdas, and Rose 2021) . Reverse logistics decreases reliance on energy and landfills, which minimizes the amount of waste that is dumped into the environment (items are reused rather than using fresh resources) (Amemba, 2021) . Unwanted waste is becoming more expensive to send to the landfill, which motivates businesses and groups to find more affordable solutions to disposal (Banadda et al., 2019). In addition, due to environmental rules, many items cannot now

longer be disposed of in landfills (Grabara et al., 2015). Thus, reverse logistics helps businesses cut costs, save energy, release fewer pollutants into the air and water, conserve natural resources, cut waste, and prevent the need for waste storage.

As part of their marketing strategy, many businesses nowadays make the claim that they are "environmentally friendly" to their clients. Companies are under more pressure as consumers started to choose ecologically friendly items. Companies have worked extremely hard over the past 20 years to develop eco-profiles, especially in areas where people are predominately concerned about the environment (Grabara et al., 2014). In addition, since they have accepted their behaviors as normal, businesses are also accountable for the environmental activities of their stakeholders, suppliers, and consumers (Pelesaraei et al. 2017).

The gain variation orders in the supply chain from the lowest to the highest level are known as the Forrester effect in the conventional supply chain (William et al., 2022). The authors demonstrated that returned goods can lessen this effect by absorbing demand changes at the start of the chain to the point that reverse logistics is less expensive than typical variable costs, even if the recovery cost is larger than the cost of producing a new good.

2.3 Supply chain members in reverse logistics in Plastic Waste Management

Due to the expected benefits of reverse logistics to supply chain performance and the mounting demand from several stakeholders, Reverse Logistics is receiving particular interest in the field of industry experts (Afum et al., 2021). Members in supply chain reverse logistics include the producers, vendors, warehouses, transportation companies, distributors and retailers. These stakeholders play a crucial role in various ways such as product development, marketing, business administration, logistics, supply chain management, and accounting.

Producers

Dispersion refunds involve functional returns, commercial returns (e.g., wrong/damaged deliveries, unsold items), stock adjustments, and product recalls, whereas manufacturing returns include quality control returns, raw material excess, and production leftovers (Schenone, 2017).

Vendors

In the proposed system, the vendor's responsibility extends beyond just starting the VMI contract and putting it online. To strengthen its customer relationships, the vendor registers reputable distributors and retailers and uploads the transportation costs associated with delivering the new order schedule to the retail stores it has been given as assignments (Debe & Omar, 2020).

Warehouses,

According to the conventional topic, we define warehousing for RL as all actions intended to preserve the current conservation status of waste that needs to be recovered (i.e., from inspection/testing activity to RL activities prior to recovery) or the changing consumption status of waste that has already been recovered (William et al., 2022).

Transportation companies

Moving secondary resources through the processing stream is referred to as transportation (William et al., 2022). The location of the facility is influenced by the cost of raw material transportation (Schenone, 2017). Schenone (2017) also added that there would be a significant improvement in the control of product flow after disassembly and recycling are taken care of which makers will need to take this issue into account, and the places for fresh assembly, disassembly, or recycling need to be well planned.

Distribution centers

The registered distributor also accepts responsibility for updating the order's status and notifying the vendor when the orders are dispersed to retail locations, as well as agreeing to pay a predetermined deposit in return for the delivery fee specified in the contract (Debe & Omar, 2020).

Retailers

The registered retailer uploads the sales report for a given time period and thereafter accepts the new order price established by the vendor by agreeing to pay a portion of the payment in advance; the remaining payment is then made when the retailer receives the order at the time and date planned (Debe & Omar, 2020).

2.3.1 Role of Supply Chain Members in Plastic waste Management.

There is a growing concern about plastic waste around the world. Our environment and health have been harmed by the significant growth in waste plastics. Thus, a systematic and scientific method of plastic waste disposal is recommended to safeguard the life of environmental habitats. Waste disposal can be done either by recycling, incineration, or landfill. As a means of recovering energy from heavily contaminated plastic, incineration is preferred over landfilling. Nabavi-Pelesaraei et al. (2017) prove in their study that incineration can be a more cost-effective and viable alternative to landfilling. However, disposing of plastic waste by incineration and landfilling damages the environment and societal wellbeing. While incineration may be considered an option, it produces hazardous pollutants such as dioxins and furans, which are highly undesirable (Tesfaye, & Daniel 2020). Additionally, plastics have the potential to stay in the soil for 300 years, and slowly release methane gas into the atmosphere if landfilling is used as the means of plastic waste disposal (Vignati 2019). When solid wastes are dumped, buried, or burned, it causes pollution and increases the quantity of solid waste accumulated over time. Moreover, landfills can be dangerous because of the high concentration of non-biodegradable (plastic) goods that slowly leak poisonous chemicals into the surrounding area (Nabavi-Pelesaraei et al. 2017). Thus, recycling of plastic waste is more environmentally friendly than incineration or landfilling. Apart from reducing waste disposal and oil usage, recycling plastics creates jobs and increases the operating efficiency of industries (Campos 2019). Wang et al. (2019) support the idea of waste plastic recycling by developing the technology of flotation as a promising waste plastic separation method that has the potential to reduce adverse environmental effects, offer qualified inputs, and increase plastic recycling efficiency. It is possible to incinerate and landfill other waste which is bio-degradable after separating plastics by using floatation technology. Another technology called “Waste treating Waste” was developed by Wang et al. (2019) which converts waste plastics into Fenton-like catalysts used for wastewater treatment. The application of this innovative strategy reduces the disposal of waste plastics in the environment. Moreover, Plakas et al. (2020) built a novel waste tracking system for monitoring plastic packaging waste, contributing to global efforts to combat the problem of environmental pollution by plastic bottle manufacturers

To address social impacts, many organizations are seeking ways to reduce waste, minimize raw materials usage, and create closed loops within the industrial system. The circular economy has become a popular concept in recent years, promoted by various governments and businesses

worldwide due to its potential economic benefits. Implementing a circular economy can occur at three different levels, ranging from national and regional levels down to the product level. From an international perspective, McDowall et al. (2017) highlight the different focuses of China and Europe when it comes to the circular economy. China is primarily concerned with mitigating pollution during its rapid growth, while Europe emphasizes green product design and resource efficiency, leading to new business opportunities (Yuan, Bi, and Moriguichi 2008). These approaches involve taking different actions, with China enforcing the circular economy more rigidly, while Europe pursues opportunities for economic growth through eco-friendly practices.

In fact, there are many types of packaging materials in general use, such as plastics, paper, metals, glass, and multi-material multilayers. Plastic plays a significant role since it takes up more than 40% of the demand. Consider the advantages of plastics: durable, light, and cheap, there are over 30 types of family-use plastics, which could be made in different kinds of plastics products for various purposes. With the expanding use of plastics, plastic production is becoming another challenging issue nowadays. Over the last 50 years, plastic production has surged from 15 million tons to 311 million tons (World Economic Forum, 2016). Moreover, as predicted, global plastic production will continually double in the next 20 years. The single-use food and drink plastic packaging could be seen as everyday items in the oceans and coastline from a global perspective. According to the report from the Ocean Conservancy (2017), the overwhelming majority of plastic waste ends up in landfills and finally floats into oceans each year. From the ecological perspective, the widespread use of plastic debris negatively impacts wildlife and the environment at every level, causing irreversible harm to oceans. Meanwhile, with the increasing environmental protection awareness, 40% of consumers frequently store plastic shopping bags out of habit. However, only 8.5% of stored plastic bags were recycled because consumers could forget to bring them or run into unplanned shopping trips (Edgington 2019). To better understand the significant incentives of plastic usage habits, research has been conducted to investigate how initiatives impact the use, reuse, and disposal of plastics. Martinho, Balaia, and Pires (2017) point out that plastics' tax implementation could lead to a 74% reduction in plastics bag consumption. Meanwhile, the financial incentives and penalties are significant to enhance existing behaviors of plastics reuse. Therefore, the usage of plastic bags dropped more than 90% after the involvement of consumers.

Although consumers' involvement could significantly reduce plastic packaging, no one can deny the significant role of recycling from the manufacturing and retail perspective. First of all, the material flow under recycling refers to reprocessing the plastics into a secondary material for future plastics generation, reducing plastic waste (Geyer, Jambeck, and Law 2017). At the regional level, more countries realized the importance of recycling plastics. For all Europe 28 states, the material recycling rate was around 42%. Some specific goals urge more recycling processes and innovative plastics products: all plastic packaging should be reusable or recyclable in a cost-effective way by 2030 in the EU market (Foschi and Bonoli 2019). However, compared to the EU, Japan's material recycling rate is around 23%, becoming a significant concern (Yolin 2015). Thus, authorities promote the development and usage of petroleum-based plastics substitutes, cumulating a 25% reduction of single-use plastic waste by 2030. Meanwhile, call for higher utilization of reusable and recyclable design for packaging products: 100% effective use of circular economy measures by 2035 (Japan Environment Quarterly 2019).

2.3.2 Tools and Approaches in tackling Plastic Waste in Supply chain Reverse Logistics

Plastic management has been reorganised by several organisations and has resulted in key tool and approaches in tackling this includes land filling, plastic incineration etc.

2.3.2.1 Land filling

A landfill is an engineering pit that is specifically created for accepting compacted waste products and outfitted with a special covering to enable the disposal of the waste (Siddiqua et al., 2022). In light of the fact that the majority of today's plastic is derived from non-biodegradable materials, land filling with plastic would entail burying the hazardous material for an extended length of time before it naturally dissolves (Murti, n.d.). In order to reduce volume, landfills are designed to receive concentrated waste in compacted layers (Siddiqua et al., 2022). Landfills are made to store and dispose of waste (Daria, 2019). Mixed waste plastics might likewise be disposed of in a landfill straight away using MSW (Chen et al., 2019). Waste is finally placed into municipal waste cans, where it is eventually collected by local municipalities and taken to waste disposal facilities be discarded in landfills in addition (Thakker & Narayanamoorthi, 2015). The expense of collecting and transporting solid waste to a treatment facility or landfills is included in the total cost of waste management (Idumah & Nwuzor, 2019). Land filling takes up a lot of room and is bad for the ecology (Thakur et al., 2018).

2.3.2.2 Plastic Incineration

The most common way to recover energy from municipal solid waste (and some forms of industrial waste) is to burn it. More than 450 waste-to-energy plants in Europe use waste incineration, and there are many more across the world (Schneider & Ragossnig, 2015). The burning of plastic waste offers an alternative to landfilling, but there are rising worries about the possible atmospheric emission of dangerous chemicals during the process (Okunola A et al., 2019). Therefore, according to certain conditions, it is feasible to burn waste as fuel license only in line with regulatory specifications and technologically advanced incinerators with flue gas filtering equipment and continuous combustion gas monitoring (Nagy & Kuti, 2016). From an energy standpoint, plastic waste incinerated generates income (Gradus et al., 2017).

2.3.2.3 Plastic recycling

Plastics are useful materials with a wide range of uses in daily life and are widely used in both industry and households (Milios, Holm, et al., 2018). Although recycling has been acknowledged as the best way to manage plastic waste, little is understood about the specific traits of plastic waste and how these could hinder recycling (Faraca & Astrup, 2019). Plastic that has been recycled is often employed in the manufacturing sector to prepare goods. Utilizing recycled materials is a better solution for cost reduction and also contributes to waste reduction because industries are increasingly focused on cutting costs (Singh et al., 2017). Due to the extensive spectrum of recycling and recovery processes, plastic recycling terminology may be complicated and occasionally confusing and these fall into four groups: the first (mechanical reprocessing into secondary (mechanical reprocessing into goods needing fewer qualities), tertiary (recovery of chemical ingredients), and quaternary (a product with equal attributes) (recovery of energy) (Hopewell et al., 2014).

2.4 Supply chain Challenges in Plastic Waste Management through Reverse logistics

One of the key reasons why industries have not yet used reverse logistics is technical challenges. These are frequently difficult to overcome, and the limited available remedies are also quite expensive, creating an economic issue. There are three categories of technical issues: material, network, and product related (Amico, 2021). According to Amico (2021), regarding reverse logistics, the network structure presents another technological challenge and the return procedure must be created in accordance with the company's requirements and financial capabilities.

Even if the product is perfectly functioning, the producer runs the danger of dealing with a lot of returns if they give confusing information about it (such as the technical specs) (Vijay Natarajan, 2022). Another area where clients want assistance is in the product selection process to help them avoid making unneeded purchases and subsequent returns. Providing thorough inventory catalogs and identification guides is one approach to assist clients in making knowledgeable purchase decisions (Vijay Natarajan, 2022). To promote engagement and decrease user-related mistakes that might lead to an increase in returns, suppliers may also decide to offer educational content online or send their products with "Quick-Start" product inserts (Vijay Natarajan, 2022).

The financial, social, and political difficulties that reverse logistics face frequently coincide to some extent. The execution of solutions to political problems is driven, particularly, by societal ideals which might be categorized as legislative, operational, and strategic difficulties (Amico, 2021). According to Kosacka (2020) reverse logistics research is heavily concentrated on a select few nations, including China, the United States, and India. This enables businesses in these countries to have the expertise needed to create such networks (Amico, 2021). The biggest operational issues relate to the absence of political and governmental backing for businesses using reverse logistics according to Amico (2021).

Many stakeholders are hesitant to engage in businesses utilizing these networks because of the uncertainty in reverse logistics (Amico, 2021). The management of the industries dealing with the Closed Loop Supply Chain problem lacks commitment as a result of this phenomena (Amico, 2021). Dishonest consumers, sadly, will try to take advantage of return policies to receive things for nothing, Reverse logistics losses can be reduced with a well-planned return strategy that includes limitations such return cutoff dates (Newcastle Systems, 2022).

Customers who purchase goods for themselves or their companies anticipate receiving the same level of customer care as if they were making an in-person purchase as they want to know how much inventory is still available, how quickly packages are delivered, and how simple it is to make returns (Nessadora silitonga, 2022). Companies are incentivized to enhance their returns management systems to keep up with client demand and stay competitive (Nessadora silitonga, 2022). There is a possibility of losing control if third-party logistics are engaged. Where the third party logistics provider does not extensively connect or communicate with the company's client or supplier, it is especially prominent in outbound logistics (GoPigeon, 2016).

Twelve impediments to recycling plastics were identified, and their interactions were examined by Satapathy (2017), absence of government policy on plastic recycling, lack of public knowledge, low demand for the recycled product, lack of labeling, cheap landfill cost and hazardous gas, energy and waste, financial help, amount of scrap, process and usage of additives are the primary challenges. (Mwanza & Mbohwa, 2017b) highlighted the five primary hurdles to the sustainability of plastics businesses. Technology, demand and quality, capacity and cost, market share and legislations and environmental concerns are the biggest impediments.

Miller et al., (2014) investigated the issues surrounding plastics recycling in the automobile industry, and they found that there was a lack of demand for recycled goods, high infrastructure costs, a lack of technology, and a knowledge gap between producers, customers, and end-of-life facility owners. Plastic recycling's market value chain research revealed low demand as a result of cost considerations, inadequate traceability, limited transparency in value chain activities, and poor design as the biggest barriers to marketing recycled items are shortcomings in the recyclability of materials (Milios, Holm Christensen, et al., 2018).

2.5 Effects of plastic waste

Human populations are linked to the distribution of plastic waste. The need for plastics and plastic items has increased as the human population has grown (Okunola A et al., 2019). Depending on the kind of plastic, many different kinds of compounds are present the inclusion of Chemicals are mostly to blame for these polymers' increased versatility, although this has drawbacks as well (Subba Reddy et al., 2014). Some of the chemicals used in the manufacture of plastic have the potential to be absorbed by people via their skin. On how badly these substances damage human physiology, nothing is known (Subba Reddy et al., 2014). On contact with human skin, several of the chemicals used in the manufacture of plastic might result in dermatitis. These hazardous substances are only utilized in tiny amounts in many plastics, but extensive testing is frequently necessary to make sure the poisonous substances are kept inside the plastic by an inert substance or polymer (Subba Reddy et al., 2014).

Land Degradation Plastic goods are widely used in the workplace and in domestic settings. Plastic pollution and plastic product contamination can harm and contaminate the terrestrial ecosystem and then spread to the aquatic environment (Okunola A et al., 2019).. Plastic additives (such as stabilizers, harmful colorant moieties, plasticizers, and heavy metals) can leach and eventually

percolate into various aspects of the environment, causing soil and water contamination (Okunola A et al., 2019). Dumping plastics on land or landfilling plastics causes abiotic and biotic degradation of the plastics (Okunola A et al., 2019).

Plastic waste that has been landfilled eventually breaks down, releasing carbon dioxide and methane into the atmosphere (Okunola A et al., 2019). The amount of CO₂ equivalent (eqCO₂) that was emitted into the atmosphere in 2008 as a result of the breakdown of solid waste in landfills was calculated at 20 million tones (Okunola A et al., 2019). Additionally, when plastics and other plastic items are burned, CO₂ is released into the atmosphere, and this CO₂ has the ability to trap radiant heat and prevent it from escaping from the planet, thereby creating global warming (Chandegara et al., 2015).

2.5 Regulatory framework governing plastic waste management

Concerns over plastic pollution have forced governments, businesses, and academic institutions to advocate for more sustainable alternatives at all levels, from the global to the local (Silva, 2021). Among other objectives, these policies and programs seek to advance bio based solutions, decouple energy from fossil fuels, strengthen local economies, protect ecological and human health, and mitigate climate change (Papers, 2013; Silva, 2021). These policies/strategies vary from each other depending on the country or the particular governing body/union and the type and amount of waste generated, also most of these strategies/policies are structured in a way to manage waste generated from the production stage through to the recycling phase.

Realistic regulations that are strictly adhered to and implemented are required in order to combat and stop the environmental pollution caused by plastics. Here we take into account the Korean Plastic Waste Control Plan (PWCP). According to Shin et al., (2020), phasing out items that are challenging to recycle design of a product that emphasizes recycling, Increasing producer accountability are done during production, the consumption phase emphasis a reduction in the usage of throwaway products in the consuming portion while minimizing packaging in the distribution part, Clean separation and discharge of consumers, Increasing government assistance for the private sector and improving public management of blind spots are strategies and lastly when recycling, expansion of the demand for recycled goods the quality of recyclable materials is being improved Market for recycled goods stabilization. Regardless of whether plastics are

hazardous, it is crucial for the government to enforce and put into place regulations that will limit plastic production, consumption, usage, and eventual disposal (Alabi et al., 2019).

The general people have to be made aware of the possible negative effects that plastic waste pollution might have on the environment and public health. By altering people's knowledge, attitudes, and behaviors toward plastic waste management, it will become more popular among the general public and help to reduce the amount of plastic waste produced (Chow et al., 2017). All stakeholders should be significantly involved in increasing the effectiveness and efficiency of plastic pollution awareness campaigns. Research on the methods and techniques teachers use to educate about environmental pollution, and notably plastic waste, is lacking (Dalu et al., n.d.).

In Ghana for instance, numerous waste management policies have been introduced from educating the general public to initiating specific policies to counter plastic waste generation and recycling. An example of this waste management policy is the “Sachet Water Producer Recovery Programme”. The term "producer recovery model" refers to businesses that create sachet water and merchants of plastic goods who set up their own sachet waste recovery systems by taking on physical and monetary liability for the end-of-life management of their products (Quartey et al., 2015). Small- to large-scale manufacturers of sachet water and commercial manufacturers of plastic can both use the approach. Companies that sell bottled water and sachets might set up a diverse reverse logistics network in Ghana to recover sachet waste (Quartey et al., 2015).

Ghana has a long history of seeking to preserve the environment from being harmed by passing suitable laws that includes environmental protection. The Environmental Protection Agency (EPA), which was established in 1994 by an Act of Parliament (Act 490) and has the authority to regulate activities within the environment, including solid waste management (SWM), is the finest outcome of these efforts (Bowen & Kayaga, 2020).

Implementing and managing RL typically depends on (i) the cooperation and involvement of the key stakeholders, (ii) the shared duty of bringing back end of life (EOL) items through the reverse SC, and (iii) the resources allocated to RL operations, due to these factors, the stakeholder theory serves as the main foundation for this study (Govindan & Bouzon, 2018). Reverse logistics interest is anticipated to come from a firm's internal feeling of responsibility for the community in which

it operates as well as from the external environment (regulations and consumers) (Armstrong et al., 2021).

Strict environmental laws emphasize the expanded producer duty; as a result, businesses have the right to recover their products or accept returns because they are responsible for the whole product life cycle (Armstrong et al., 2021). According to Armstrong et al., (2021), the manufacturers are required to accept the items back in particular industries, such as the car industry. Regulations dictating the prevention of waste and promoting waste recovery, particularly in the European Union, include the End-of-Life Vehicles Directive (ELV), Waste Electrical and Electronic Equipment Directive (WEEE), Restriction of Use of Certain Hazardous Substances Directive (RoHS), and Packaging and Packaging Waste Directive.

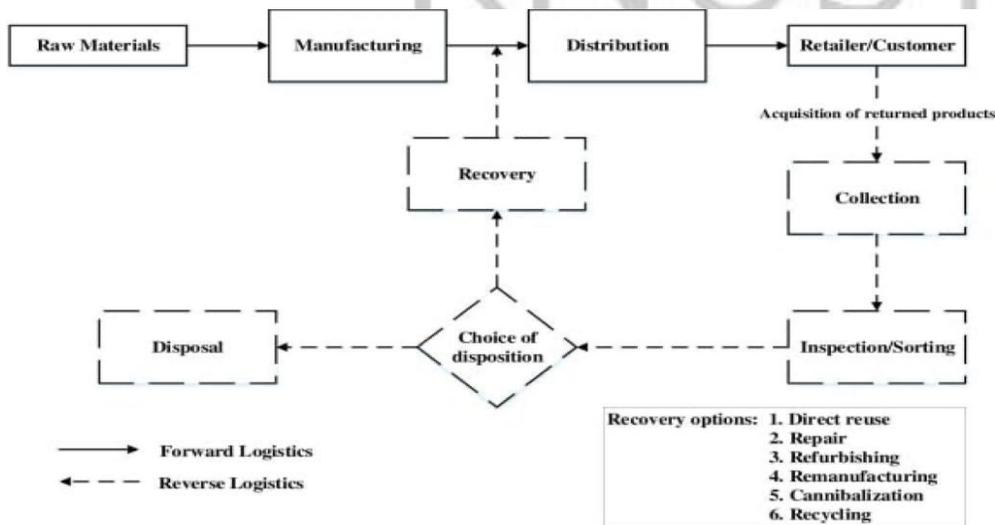
Additionally, environmental laws have become increasingly prevalent worldwide, but particularly in Europe, examples include laws governing packaging, recycling limits, and factory take-back obligations (Story, 2011). In order to safeguard the environment, the European Union wants to stop waste from end-of-life cars and encourage the gathering, reusing, and recycling of their parts (Armstrong et al., 2021).

The increased incentive for global environmental awareness and sustainability has influenced green supply chain management ideas and practices through government pressure and regulation (Bazan et al., 2016; Sheu & Chen, 2012). The Extended Product Responsibility (EPR) regulation, which emphasizes the life-cycle and environmental performance of products, is one such strategy (Bazan et al., 2016). An effective market-based policy strategy that may considerably support a circular economy in the construction sector is determined to be extended producer responsibility (EPR) (Shooshtarian et al., 2021). The Organization for Economic Cooperation and Development (OECD) defined EPR as a strategy for environmental policy in which a producer's accountability for a product extends to the stage after the consumer in the life cycle of the product (OECD, 2016).

There is presently no national law in Ghana that specifically permits manufacturing companies to return products for reuse and recycling. Afum et al. (2019) stated that Ghana has adopted Reverse Logistics as a Green Strategy initiative as a reflection of the top management support. Nevertheless, the Environmental Protection Agency is persistently pushing businesses, particularly those in the industrial sector, to focus on implementing RL practices as it is being done

with the assistance of the government (Afum et al., 2019). Under the extended producer responsibility, the EPA is in charge of maintaining the infrastructure for collecting locations and transporting e-waste to the plant as the agency also grants licenses to other commercial operators (Onianwa, 2019).

2.6 Conceptual Framework for Waste Management Through Reverse Logistics



This conceptual framework provides pictorial representation of the entire work. It indicates how plastic waste management can be achieved. It starts from the point where the plastic raw materials are used by the manufacturers then distribution takes place to the retailers and consumers. Now, what is key is how these plastics used by the retailers and consumers are disposed. From the framework this could be through collection of the waste of which some organization either public or private stakeholders are involve. After this inspection and segregation of the waste by type are done as different types of waste requires different approach to manage it. The sorting begins recovery process where it goes through recycling for the plastic to be used back through a channel of reverse logistics. This process reduces the plastic waste for most societal benefits and economic value

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter outlines the research approach and strategy, the research design and population of the study. It also discusses the sample and sampling procedure, instrument for data collection, reliability and validity test and data analysis procedure employed.

3.2 Research Approach and Strategy

The research methodology explains the connections between and the order of the theory and the actual investigation. The study used previously published scholarly material as its theoretical foundation and used it to generate the objectives that were then evaluated, resulting in a deductive research approach. As a research methodology, the study used a qualitative technique. According to Hanson et al. (2012), the understudied research problem has influenced the use of a qualitative approach. The selection of a qualitative study suggests the necessity of investigating the role played by certain businesses in the management of plastic waste through reverse logistics (Smith 2018). The study's use of qualitative research gave detailed information, improved comprehension of the varied practices used by these businesses and demonstrated the efficiency of reverse logistics. This method also helped to accomplish the study's goal by giving context to respondents' opinions and revealing fresh data on the management of plastic waste (Bacon-Shone 2015).

3.3 Research Design

A research design is a technique to exploring a topic or a method used to answer the research question. It specifies the processes and measurements to collect data (Sileyew, 2019). Different types of research can be categorized using a number of elements, including the research method and the study's aims. However, the research problem ultimately dictates the research strategy (Walliman, 2017). Descriptive research, which also describes situations, offers responses to the who, what, when, where, and why questions (Burns & Veeck, 2020). A complete and accurate situation account is what it aims to elicit (Cant, 2011). Studying the rationale behind the use of reverse logistics is the primary goal of the descriptive research design in this study. Researchers need to collect and analyze the opinions and behaviors of the sample as well as properly explain the measurement and population (Yang, 2017). The study used descriptive approach to determine

a comprehensive understanding of businesses' behaviors, attitudes, and other traits towards the adoption of reverse logistics.

3.4 Research Purpose

This purpose of the study is describing the role of companies in waste management using reverse logistics. As such, the study used thematic approach in analysing and summarizing data on the issue of code of the waste management approaches to meet the objective of the study. In this regard, purpose of the research was to meet the objectives of the study through the use of detailed information gathered from respondents for analysis with the aid of thematic approach.

3.4 Population of the Study

According to Saunders et al. (2016), a population is a universe, people, or things that need to be studied. This is bolstered by Kumar (2018), who indicate that population-based studies are more representative. The target population of this study is employees of firms in Ghana that have plastic waste as their products and by-products.

3.5 Sample Size and Sampling Procedure

The sampling procedure is the technique used to collect objects, people, or study locations. It requires choosing study population objects and subjects in a way that is representative of the traits of the entire population. The choice of the staff was deliberate. People who work for companies that produce plastic waste as products or byproducts are the selection criteria.

One of the most important research tools, sampling is frequently used for reliability and validity purposes. As a result, the study decided to choose a non-probability sample for the purpose of selecting respondents. The researcher has the option to choose respondents using this sample strategy at his or her choice. The purposive sampling technique was chosen for non-probability sampling. Using this sample strategy, the researcher was able to choose respondents based on their expertise and background in the area of study (plastic waste management). As a result, it guarantees that respondents who were randomly selected for the study are fully informed about it. Administrators and managements were chosen for the study's analysis based on this. The sample size for representing the study's population was created using the sampling methodology. A sample is described as a collection of individuals drawn from the target community who share the traits of the entire population under study. According to Fugard & Potts (2015) and Clarke & Braun

(2013), a qualitative study should have a minimum sample size of 12. Therefore, it was determined that a sample size of 15 respondents was adequate for the investigation; however, due to respondent unavailability, the study only included 12 respondents.

The study selected respondents from each of the companies. The management, the administrators and the operators in charge of plastic waste management. Respondents were selected based on the objective of the study, that is, respondents sampled for the study were people who work for companies that produce and package in plastic bottles and bags and had knowledge about the study being conducted.

3.6 Instrument for Data Collection

The type of research instrument utilized depends on the time, type of research, and population. This is why the interview guide was chosen as the data gathering tool. The researcher's main goal is to gather in-depth, firsthand information about participant experiences with waste management strategies. To do that, semi-structured, in-depth one-on-one interviews were used. Semi-structured interviews give the researcher and participant the opportunity to converse in real time, enabling the researcher to achieve the previously stated objectives (Pietkiewicz et al., 2014). A careful evaluation of the literature informed the design of the interview guide in order to guarantee that the information provided reflected the study's purpose. Thus, issues of waste managements were structured in terms of the plastic waste management using reverse logistics so as to provide stronger basis to meet the objective of the study.

Participants were encouraged to express themselves freely on topics related to managing plastic waste, which allowed for the emergence of novel and unanticipated issues that the researcher could delve deeper into with additional inquiries. The study was able to learn more about the company's strategy for dealing with plastic waste management thanks to in-depth interviews conducted in a semi-structured manner (Esterberg, 2002). It gave the researcher the chance to delve extensively into comprehensive accounting depending on the function of each organization. It was intended to elicit their opinions on the matter, and as they had access to first-hand knowledge from businesses that actively engage in such management, they were able to offer in-depth explanations of the problem.

The researcher used a tape recorder to capture the responses provided in order to ensure that vivid information was analyzed. Esterberg (2002) argued that it is preferable to gather data at a time and location that is convenient for the responder. As a result, the research was conducted in a way that guaranteed a higher participation rate from the respondents and relaxed information sharing by participants.

3.7 Sources of Data

The researcher was able to assess different companies' waste management strategies by contrasting them with those of other businesses in Ghana and throughout the world using the data sources. Additionally, it made sure that additional empirical studies that were relevant to the topic were reviewed. Additionally, the sources of data made it feasible to have first-hand knowledge about the reverse logistics. Therefore, primary and secondary sources were used to gather the data for this study.

3.7.1 Primary Sources

The primary sources of data were sought mainly based on the objective of the study. Thus, respondents' opinions and role in plastic management were of importance to the study. Also, issue regarding the challenges faced in the management of plastic waste were of much importance to the study as the researcher obtained information administrators, managements and worker. Thus, the primary sources of data for the study were first-hand information collected from respondent at the various companies that have plastic waste as by-product.

3.7.2 Secondary Sources

The secondary sources of data entailed information about the waste management approaches within an organisation. Also, the study reviewed empirical and theoretical literature in the area of organizational performance and challenges in practicing waste management.

3.8 Validity of the Research Instrument

3.8.1 Pilot Study

Before beginning a larger research study, a pilot study is a small-scale preliminary investigation carried out to assess feasibility, time, cost, and adverse events as well as to enhance the study design (Kumar, 2018). The purpose of the pre-testing of the research instrument is to find the instrument's weaknesses. This allows for the enhancement of the

instrument's ambiguous and unclear parts. The validity of the study instrument was pretested by the usage of the pilot testing.

3.8.2 Validity

According to Saunders et al. (2016), the validity of a research instrument is the extent to which it captures the objectives of the study. Construct and content validity were both used in the study. In order to ensure that related topics are included in the study, it is necessary to develop questions that accurately reflect the topic at hand (Kumar, 2018). This makes certain that every part of the research is covered. Content validity was guaranteed by my supervisor and my colleagues evaluating the research tool. The degree to which an instrument measures the notion or theory it was designed to measure is known as construct validity. This was accomplished in this study by a survey of the relevant theoretical and empirical literature.

3.8 Data Analysis

The study's methodology was an inductive one that utilized qualitative data and content analysis. The study by Eyisi (2016), which stated that this method tends to produce data collection where the researcher first conducts observational approach and then identify some level of patterns through the observations of variables on the field in order to generalize the outcome of the study from the themes created, provided the basis for this principle.

In practice, information was generalized into uniform units depending on the study's goal in order to generalize the data collected. The collected data were coded into simple to comprehend themes and concepts to allow for quick and efficient analysis. Thematic analysis was used to examine the data that was gathered from respondents. Editing the material for consistency was done before using this method for the analysis. This allowed for an evaluation of the information's appropriateness and correctness. The final data were then thematically analyzed with NVIVO's assistance. This was done to build a link between supply chain management and waste management. These collective responses were from respondents who offered data that was analyzed to fulfill the aims of the study.

As a result, Thomas' (2006) broad inductive approach to assessing assessment data was used to analyze responses in an effective way. The five main steps of this method were as follows: The initial step in this process is called raw material preparation, which also refers to cleaning up raw

data. In other words, the researcher accurately transcribed the audio recordings using the details provided by participants. The audio recordings were listened to numerous times to make sure the data used matched what the participants had said.

Also, the researcher used a close text reading strategy to familiarize herself with the information provided. This made it possible to identify the themes in the material provided by respondents for the study's analysis.

The investigation of the themes produced categories of patterns, concepts, and qualities. Sub-themes were created as a result from the participants' real phrases. While overlapping themes and categories were integrated, content that had no bearing on the study's goal was removed.

Information on novel insights and opposing viewpoints was looked up from the categories and subtopics that the text's categories and subtopics had generated. When the themes appeared to have a similar meaning, they were occasionally blended, and themes that fit the objectives were chosen as a result.

Limitation

The study is envisaged to face challenges as qualitative research are not subject to quantification or quantitative analysis, but subjective observation and analysis of the respondents. The study can be influenced by the respondents' intuition and their level of in-depth knowledge about the subject on hand. Access to some selected management for one-on-one interview was a challenge due to their busy schedule. Therefore, other means such as phone call, mailing and follow-ups was done to achieve target of the respondents. In addition to the challenges, was geographical location of the targeted organisation or companies, this implies travelling long distances from one geographical area to the next. To avert this challenge, there was the need to ensure scheduling of meetings. Also, time frame to conduct detailed study on this subject was limited as well as financial constraints of the researcher to conduct a detailed analysis of the study.

3.9 Ethical Considerations

Research ethics is the appropriateness of the researcher's conduct in respect to the rights of individuals who become the focus of a research study or who are affected by it, according to Saunders et al. (2016). In the reporting of the study's findings, each respondent was given the

assurance of anonymity and confidentiality. This was stated in the study instrument's introduction. Before beginning the data collection process, the researcher secured the subjects' agreement. A consent document was also given to the participant by the researcher. The consent form contained the following information: a brief summary of the study's purpose, a description of the activities and time commitment involved in participation, a statement stating that participation is voluntary and subject to termination at any time without penalty, the researcher's name, along with additional contact information. The participants' identities were protected and confidentiality was upheld. In the course of the interview, the researcher also requested the respondent's consent to speak with them and record the conversation.



CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND DISCUSSION

4.0 Introduction

This chapter focuses on reviewing the data gathered, analyse the information, and juxtapose the outcome to other related studies. It considers the management of plastic waste through the use of reverse logistic in some companies in Ghana.

4.1 Institutional Information

The study selected four institutions for the data collection and analysis. Among the four institutions, three institutions were organisations that use plastic materials in packaging their products. Whereas one of the institutions was a waste management organization. From the four organisations, twelve participants were selected; four of the participants were from the Kasapreko company, three from the from the ABL company, three from the Zoomlion and two participants from the ATOSCO company.

This was the information gathered from ATOSCO Ventures and what they do;

.....we deal in publication and also, we have an aspect of the company that deals with water manufacturing, so we are located in Ga – South Municipality, and then we produce ‘Star Drop Water..... our company has been in existence for about 8 to 10 years now..... it’s a family organisation, we have about 15 to 20 employees which include other family members and recruited staffs.

The study gathered information on ABL company;

.....so um, the company was first formed in May 1931, but was initially called overseas, Overseas Bureaus right, so it’s bureaus, so it was, it’s gone through a number of um, ownership, and then eventually it was handed over to the government. I think somewhere the 90’s it was sold to South African Bureaus, which is SAB.....

.....and whiles it was growing up, today they open the company and then they introduced new products like the Castle Gold Stout in addition to the other

products that we have and um, 2017, 2016, it was sold to so that's the company that produces, so you see, that sponsored the world cup, so um, yeah so, it all about products includes Club Beer, Club Shine Bureau, Gold Lager, Gold Stout, Beta Malt.

Another company information gathered was Kasapreko;

..... So Kasapreko Company Limited is a Ghanaian beverage manufacturing company that specializes in the production of alcoholic and non-alcoholic beverages. It was founded in 1989 by Dr. Kwabena Adjei, a Ghanaian entrepreneur. The company is named after Dr. Adjei's hometown, Kasapreko, located in the Ashanti Region of Ghana.

The fourth organization's information was Zoomlion which is a waste management organization;

.....So, Zoomlion started in 2006, right, um so, up to now I think is about 16 or 17 years now. Basically, in an environmental and sanitation sector, um, using very simple and moderate, um, simple equipment like tricycle to collect waste, initially it was just collecting waste and dumping at a land fill site, but overtime we have introduced best practices like, been used to cut recycling, so that we can add some to the material we will recover and then reduce what is thrown away into what we call the landfill at the disposal site.....

..... so that is what the company has actually been doing about the past 16 years and the plan, um, increase the share of these sites been used and then using the waste material for better things than just throwing away, so that's the long term strategy of the company, and um, it has the mandate to collect waste from municipal areas and then some industrial areas, and so we have contractual agreement with clients on behalf of the assemblies.....also we have a contract to manage their waste for them so that, these are the main models that is being run by the company.

These organisations engage in plastic materials either in terms of their packaging or in terms of collection. These organisations provided detailed information on plastic waste management and the reverse logistic which will be discussed in detailed.

4.2 The Kind of Plastic Waste Produced/Used

Participants from the three organizations that use/produce plastic materials for packaging were asked to identify the kind of plastic waste produced/used from their production to distribution.

4.2.1 Plastic Sachet

The study found that one of the organisations selected for the study uses sachet plastic in their production. The participant acknowledges the presence of plastic waste originating from the rolls used in sachet production. Sachet water is typically packaged in thin plastic sachets made from materials like polyethylene or polypropylene. These materials are not easily biodegradable, leading to long-lasting environmental pollution when improperly disposed off.

This is what participant 1 from ATOSCO had to say;

.....mostly there is water waste because we produce water and then there is plastic waste as for, that is the waste from the roll we use to produce the sachet – water....

4.2.2 Pre-Form

The report highlights that the plastic waste generated is primarily in the form of pre-forms, which are the initial shapes of plastic bottles. According to participants, these pre-forms are made from resin, a material commonly used in plastic production. The use of pre-forms allows for efficient and streamlined bottling processes.

This a comment from a participant;

.....Ok, so the plastic ones, we have some, the plastic that you see there, is called pre – formed the bottle that you see is called a pre – form, its actually produced from a material known as resin so here in Kasapreko we produce our own preforms, um, is more of a one stop shop, whereby we produce our, our preforms, we produce our drinks, we bottle it and then we sell but the preforms is one way, is one way, one way, meaning that when we use it on the line we don't reuse it again.

4.2.3 Glass bottle

During the interview, one of the companies mentioned that only one product is produced in plastic bottles. Other products are packaged in glass bottles. According to the interviewee, for the glass bottles, the expectation is that they are returned after trade. However, there are instances where some bottles are not returned. To address this issue, the company has implemented initiatives to gather the non-returned glass bottles. These initiatives aim to ensure the proper management of packaging materials and reduce waste. However, it should be noted that plastic bottles are not retrieved after usage.

This is what the participant indicated;

.....so the only soft that we do is Beta Malt, yeah, so that's the only thing that goes in the plastic, the other, the others we do goes in the, glass bottles, so those ones the expectation is that when it goes to trade, its suppose to come back but there are some that um, does not return, so for that one, we actually sought of, find initiatives that we gather them.....But for Beta Malt, that one we don't retrieve the bottles.

Another participant was of the view that;

.....so once it goes to trade, it needs to comeback, um, because it also affect the production here because when it comes back from trade, we put it through the bottle washer, but the ones that are not good is rejected and then crushed, so then the waste um, bottles we send it to the recycling companies.....so the plastic ones we sell, um some of the preforms, some of them are rejected at the filler when that is not of the right quality.

4.3 Reverse Logistic Strategies in Plastic Waste Management

Plastic waste management through reverse logistics is an essential component of addressing the environmental challenges posed by plastic waste. Thus, this section of the study provides detailed information on various strategies adopted by various organizations in waste management. By integrating reverse logistics into the sanitation value chain, producers can ensure that waste materials are managed responsibly, reducing environmental impacts and promoting sustainability.

4.3.1 Segregation and collection of Plastic waste

During the interview, the interviewees explained the process of segregating plastic waste. Upon its arrival, plastic waste is first segregated based on its type. Different types of plastics require different technologies for effective management. Once segregated by type, the plastics are further sorted based on their polymer composition.

This represents respondent's view;

so when the plastic comes it is segregated.....and so there are several types of plastics and then you need different technologies to manage these plastics, so after the plastics, all plastics are segregated, they are further segregated into their polymer type

4.3.2 Recycling and Partnership

Some of the companies selected indicated that they have established a partnership with a waste management company to effectively manage its production waste. The primary objective is to ensure responsible disposal and recycling of the waste materials. Through this collaboration, the companies aim to reduce its environmental impact by diverting waste from landfills and supporting the development of sustainable products through a collaboration with waste management company.

A respondent's comment;

we have this arrangement with a waste management company, which always come for our waste or production waste after we are done with production and it take elsewhere for recycling, yeah, I know they use the waste collected from our company and other water companies for products such as juice bags and even the plastic bottles it contains some of the water which we are not into that production, yeah, but then I know for sure, they use them, the waste we produce recycle them and then they get those juice bags and then sometimes the plastic bottles that we use to contain some of the water

The result of the study indicates that the waste management company regularly collects the production waste from the company's premises. The waste materials are sorted and processed at the waste management facility. The recycling process involves various steps such as cleaning,

shredding, melting, and reforming the waste materials into usable forms. The waste management company utilizes the recycled materials, including the waste collected from the company, to produce juice bags. These bags serve as an eco-friendly alternative to traditional packaging. The recycled materials undergo further processing to meet the required quality and safety standards for the juice bag production. In addition to juice bags, the waste management company also utilizes the recycled materials to produce plastic bottles. These bottles are used for various purposes, including packaging other beverages. The recycled materials are transformed into plastic pellets, which are then molded into bottles through an extrusion and molding process.

4.3.3 Building of Recycling system

An interview was conducted to gather insights and information regarding the organizations plan to implement a sustainable development program for waste management. The interview aimed to understand the objectives, strategies, expected outcomes, and potential challenges associated with the program.

Several information was gathered in the study. During the interview, it was revealed that the primary objective of the sustainable development program is to address the environmental impact caused by the organizations' waste generation. By redirecting waste to recycling institutions, the organizations in the study aim to minimize pollution and prevent waste from ending up in gutters or landfills. Additionally, the organizations seek to collaborate with external organizations specialized in recycling to ensure the effective implementation of the program.

.....We are planning to have a sustain development program in place for this year, where um, the waste that we generate we have to give back into a recycling institution so that we cannot end up polluting um..... so, we want to link up with other organization that will do the recycling because we don't recycle, we only produce and then generate some of the waste but this time around we want to learn to have it and then turn it around so that it doesn't end up in the gutters.

Ensuring a seamless process for waste collection, transportation, and delivery to recycling institutions may pose logistical challenges. According to participants, clear communication channels and efficient transportation systems will be established to mitigate these challenges. They also recognized that encouraging employee participation and commitment to waste segregation

and recycling practices may require ongoing awareness campaigns and incentives to drive engagement and at the same time, building and maintaining strong partnerships with reliable recycling institutions may be challenging. Thorough research and due diligence will be conducted before establishing collaborations.

4.3.4 Going back to the environment

During the interview, it was revealed that some of the organizations currently have a sustainable waste management practice in place. They have collaborated with an entity that collects the waste generated by the organization. This waste is then transformed into granules through a process that involves melting and processing. These granules are subsequently utilized in the production of mobile plastics and other plastic-related items. This sustainable practice ensures that the waste does not end up in landfills or harm the environment.

This is what a respondent had to say;

.....one thing concerning the waste is we have somebody currently that's the only sustainable thing that we are doing so far, who picks up the waste that we generated and we produce it into granules, these granules are then transformed to produce mobile plastics or other plastic related items, so it doesn't go straight into ground, we will process it, melt it and then turn it into granules so that it is also a business venture for we so that it doesn't go back into, so currently that's the only sustainable thing that we are doing but we want to increase that um, for things to be done out of our solid waste.

4.3.5 Resell at a discount

This study outlines the key points discussed, including the steps involved and the potential benefits for our company. During the conversation, it was mentioned that one of the companies has partnered with the preform supplier to tackle the problem of bad or defective preforms, which often contribute to plastic waste. The supplier has proposed a solution where they give the flawed preforms to a company that provide them with preforms to remanufacture them, subsequently offering them to the company at a discounted price.

This statement below was reported by a participant;

yeah, so the plastic initiative is where I mentioned, with the company that supplies us with the preforms, so they take some quantities of the bad ones and then go and remanufacture and then sell it to us at a discount of price.

The outcome of the study indicates that some companies that uses preforms, when they identify the preforms that are considered defective or unsuitable for their intended purpose. These preforms are typically discarded, leading to increased plastic waste. However, in most cases, the preform supplier collects the identified bad preforms from those companies. This ensures that the waste is effectively managed and utilized in the remanufacturing process. The supplier employs a remanufacturing process to transform the collected bad preforms into usable ones. This involves various techniques and quality control measures to ensure that the remanufactured preforms meet the required standards. Once the remanufacturing process is complete, the supplier offers the remanufactured preforms back to the companies at a discounted price. This incentivizes them to purchase these preforms instead of new ones, leading to cost savings for the company.

4.3.6 Conversion to Materials

The interviewees highlighted the need for various technologies to manage different types of plastics effectively. After segregation, the plastic waste, particularly polyethylene terephthalate (PET), undergoes a shredding process. Shredding involves crushing the plastic into smaller particles. These shredded particles are sometimes exported to facilities where they can be converted into materials such as textiles. z

This what a respondent purported;

.....and then um, for, for the PDP, we shred, shredding means we, we crack, um, we crush it into smaller particles and then they are sometimes exported to places where these can be converted into several materials like textiles, and all that..... I think is known that one of the World Cups, Nigeria actually, the jersey that the Nigerian team wore was from PDP plus, that is an example, but we don't have a local um, facility that can do the end conversion.

4.3.7 Mechanical Recycling

During the interview, the interviewee explained that the organization practices mechanical recycling as a method to repurpose waste. The waste materials undergo a process of conversion

into "pellets," which are small plastic particles. Mechanical recycling involves shredding and melting the waste to form these pellets. It found that once the waste is converted into pellets, they can serve as the base material for manufacturing various plastic products. These products include buckets, bowls, and other items commonly found in the market.

One of the interviewees revealed that;

.....we do what we call mechanical recycling, they are converted into what we call "Pellets", after they are converted into pellets, they can be converted into several products like base, like other plastic products that you see in town, and before you do that, you add the recycle tellers to what we call purging to a certain percentage, so you do that and then you can convert it to several like buckets, bowls and things, several, several products that you see on the markets

4.3.8 In-house Production

It was indicted by some of the respondents that some of the companies selected take a comprehensive approach to its production by manufacturing its own pre-forms, producing the beverages, bottling them, and then selling the final products. This integrated production system enables greater control and efficiency throughout the manufacturing process and the management of plastic.

This is what one of the respondents revealed.

..... we produce our own preforms, um, is more of a one stop shop, whereby we produce our, our preforms, we produce our drinks, we bottle it and then we sell but the preforms is one way, is one way, one way, meaning that when we use it on the line we don't reuse it again.

This suggests that despite the integrated approach by some companies to ensure the management of plastic waste their one-way approach with no reverse logistic system hinders the reuse of plastic materials that goes out to the public.

4.3.9 Throw away waste without recycling.

According to some of the participants, to ensure adherence to food safety and hygiene regulations, the company follows a disposal procedure for the rejected bottles. The liquid contents of the rejects

are disposed of separately, while the bottles themselves are discarded. However, this approach fails to take into account recycling procedure or reverse logistic approach.

.....so we produce the bottle, the preforms, it goes into the machine, it goes up into a bottle, so during the production, if there is any reject is not, it's already called a waste, if there is a reject, which because of food safety hygiene we don't reintroduce it back into the lab, you have to dispose it off, we dispose the liquid off and then the bottles we dispose it off through our waste system, whereby Zoomlion will come and pick it up.

4.4 The Role of Supply Chain Members in Plastic Waste Management.

The purpose of this objective is to provide an overview of the collaboration among supply chain members in plastic waste management in terms of reduction and recycling. This section highlights the arrangement in place, the recycling process, and the potential products derived from the recycled waste.

4.4.1 Sanitation Value Chain

The study focused on the sanitation value chain which refers to the entire lifecycle of waste management, from waste generation to disposal and reuse. It encompasses collection, transportation, treatment, and final disposal or recycling of waste materials. The outcome of the study suggests that adopting a reverse logistics approach within the sanitation value chain ensures that responsible systems are in place to handle waste materials, similar to the processes used to distribute materials to communities.

so, we have a relationship with because they mostly come for our waste products after production and then we talk to them from time to time updating them, when and when they have to come for our and then if we have any problem, disposing them off, we sometime contact them, so I will say we have a good relationship with the plastic waste management

4.4.2 Collaborate with other Organisations

In the interview, it was mentioned that some of the companies have an arrangement with disposal agencies such as Zoomlion for waste management. This arrangement ensures the proper disposal of the company's waste materials, particularly the packaging waste. The participants emphasized

that the packaging material used, which includes bottles that people drink beverages from, is not harmful to the environment. It is considered safe due to its intended use in storing beverages. Additionally, the volume of waste generated from the packaging materials is relatively low.

Another participant was of the notion that;

.....So, we have an arrangement with disposal agencies like Zoomlion and other its, one it's not harmful to the environment because it's something that people drink beverages from, it's not harmful, so, and also the waste that comes out is not that many, so we have Zoomlion picking it up.

To manage the waste effectively, the company has engaged Zoomlion, among other disposal agencies, to handle the collection and disposal process. Zoomlion, a reputable waste management agency, is responsible for picking up the waste generated by the company. According to them this arrangement with disposal agencies demonstrates the company's commitment to responsible waste management practices. By partnering with professional agencies like Zoomlion, the company ensures that its waste materials are handled in an environmentally friendly manner.

4.4.3 Recollection System

Some of the interviewees explained the process of refilling and reusing the dispenser bottles. When the organization supplies a batch of bottles to a client, such as twenty (20) bottles, the client uses them until they require more or reach a reorder level. At that point, the organization collects the empty bottles, washes them thoroughly, and refills them. Once refilled, the organization supplies the bottles back to the client for continued use. This according to the approach leads to the management of plastic waste.

.....so, we have, we have selected clients which we sell this, this bottles to, this um, dispenser bottles to, so have selected clients, so lets say local government, so if we give you twenty (20), we have a contract with you over a period of x of value bottles, so immediately its finished, its finished. We come to you, we ask you, as and when it's get finished, so if we supply you twenty (20), when you bring like ten (10) "oh we need more

or we need another ten 10”, when it comes to another reorder level, so we come and pick the bottles, we wash it, we refill, we supply.

4.4.4 Batch control System among all stakeholders

During the interview, it was revealed that some of the organizations have a retrievability system in place, managed by the Quality Control Department. The system is designed to address and manage product complaints effectively. Each product has a unique identification number or code on the label. When a customer calls to complain about a specific product, the organization engages with them and invites them to their premises for further investigation and resolution.

A respondent’s view;

.....so we, um, we have a retrievability system, which is managed by the Quality Control Department so we have um, I think there’s numbers on the label when you call complain, we engage you invite you here and we also have a blocking procedure, so we will get that batch..... um, the batch of product that was produced that day, if there is still some in stock here they block it, complain to trade and we also engage the consumers that are affected, we have a way of treating all those products of the particular batch ensuring.

This proactive approach to consumer engagement ensures that the organization maintains strong relationships with its customer base and demonstrates its dedication to quality control and management of plastic waste.

4.4.5 Relation with international Organisations

During the interview, it was revealed that the Corporate Affairs Plan aims to engage a waste recycling company from America. The objective of this engagement is to collaborate on the installation of an energy-generating plant locally. The waste recycling company possesses expertise in generating biofuels from waste materials, contributing to sustainable energy practices.

the cooperate affairs plan is trying to do is to engage the, the waste recycling company, so they are from America, so what they want to do is install a plant here, that will generate energy from waste so um, this try to generate biofuel.....they can install the plant and so they even accessed whether the waste generated from the site will be enough

to power the plant or whether they need to be supplemented with waste strategy generated in country.

The study result indicates that some of the organisations have been actively involved in ongoing discussions with the waste recycling company to determine the feasibility and implementation of the project.

4.4.6 Waste Treatment and Processing

The collected waste undergoes treatment and processing to remove impurities and prepare it for recycling. This may involve cleaning, shredding, melting, or other techniques depending on the specific material.

.....so when we collect the waste, um, um, the waste is transported by vehicles and we have a number of facilities, we have um, in Accra alone we have, there are about, two facilities that we call material recovery and composite facility, so these facilities what is does is, most of this waste, if they come in mix, the, the, the factory is able to separate the waste into different parties, so plastics will become alone, organics are separated, paper is separated and all that, so once plastics are separated they are taken to the plastic recycling facility, where currently what is done is termed technically as mechanical recycling

4.4.7 Repurpose the plastic waste by Recycling companies

The waste management company utilizes the recycled waste, including the waste generated by our company and other water companies, to create various products.

This is what a respondent intended;

Recycled waste materials are used to produce juice bags, which serve as an alternative to single-use plastic bottles. The juice bags are designed to be convenient, portable, and eco-friendly, reducing the reliance on traditional plastic packaging.

.....Some of the recycled waste is used in the production of plastic bottles. These bottles may contain water or other beverages, but it is important to note that our company is not directly involved in the production of these bottles.

The outcome of the study indicates that after treatment and processing, the waste material is transformed into new products. In the case of the waste from other companies, the waste management company repurposes it for products such as juice bags and plastic bottles. Thus, there is supply chain approach in gathering the plastic waste for reuse.

4.4.8 Production Cycle with Partners

The interviewees highlighted organizations efforts to retrieve glass bottles from the streets for reuse. By collecting glass bottles found in public spaces, some of the organizations aim to prevent them from becoming waste and instead reintroduce them into the production cycle. This practice aligns with the circular economy model and contributes to waste reduction and resource conservation.

This is respondent's comment;

so we have something that we call 2025 um, 2025 sustainability growth, so, we have four them and one is in um, climate action, um, water selection, new circular packaging, that matters with we have to do with so um, yeah so, what we do is that as part of these where we must to um, use as much recycling content in producing or in packaging, we, um, one of the things we is on the glass bottles that we talk about, we try to retrieve them from street so that we use it.

Another respondent indicated;

recently, we did a project with "GRIPE". GRIPE is I think something, something for private enterprise and so Ghana Recycle Initiative, recycle initiative by Private Enterprise, "Ghana Recycle Initiative by Private Enterprise). We engage industries that are um, you know, have a list of been huge producer and then they move in together to embark on the initiative, so we did um, a huge clean – up exercise with them.

The interview provided valuable insights into the organization's 2025 sustainability growth plan and its focus on circular packaging and glass bottle retrieval. The plan encompasses various themes, including climate action and water conservation.

4.4.9 Well Structured network of Companies for effective supply chain network

The study found that most of the companies operate through a well-established network of distributors, wholesalers, and retailers. This structure allows for efficient distribution and widespread availability of their products. The primary objective of according to participants, is that their production and distribution process is to successfully sell products through distributors and retailers, maximizing market reach and customer accessibility. The products follow a predetermined flow, starting from the production stage and progressing through distributors, wholesalers, and finally reaching retailers for consumer purchase. Even though, there was no supply chain logistic process that ensures effective management of plastic waste, there was some form of a system that ensures that some plastic materials are retrieved from the environment.

This is what respondent revealed;

.....Ok so, our production, that is we are looking at our production distributions, we move through a distributors, wholesalers and retailers, our main objective is to sell the products through our um, distributors and our retailers, however if there is any problem with the products, there is way that the distributors communicate to us so that we go and retrieve it, let's say if the product goes bad, it has been in shelf for a long time, we don't allow the distributors to dispose it themselves we do it by ourselves.

..... we pick it up because we know how distributors and people are, they can wrongly dispose it off, and which will go long way to affect us, so we go in and then we pick it up and then we come and destroy it here and then go straight to the destruction process.

Effective communication between the distributors and the companies is crucial. Distributors serve as a key link in the supply chain and provide valuable feedback regarding product performance, issues, and customer demand for effective plastic management solution.

4.4.10 Disposal Restrictions

According to participants, distributors are not authorized to dispose of problematic products themselves. This measure is implemented to prevent improper disposal methods that may negatively impact the environment or the company's reputation. This tends to provide key supply chain logistic approach that ensures proper discovery of plastic materials and adopt the best practices to ensure waste management.

One of the respondents concluded that;

.....In the event of any issues or problems with our products, distributors are encouraged to promptly communicate with our company. This enables us to initiate the retrieval process for problematic products and after the retrieval of the product, the plastic materials are sometimes used, however when there is any defect, we

4.4.11 Responsibility in plastic and other waste products

Some respondents were of the view that their company takes full responsibility for the proper disposal of problematic products, prioritizing environmental sustainability and minimizing potential risks.

This is what one of the respondents indicated;

Upon notification from distributors, our company initiates the retrieval process, collecting the problematic products from their locations. Subsequently, the retrieved products are transported to our designated facility for destruction.

The outcome of the study suggests that the destruction process ensures that problematic products are safely and effectively disposed of, mitigating any potential harm or negative impact. This approach reflects the commitment to maintaining product quality and management of waste in the environment.

4.4.12 Local Resources and Support

Waste disposal and recycling are crucial aspects of environmental protection. Proper waste management helps prevent pollution, conserve resources, and reduce the strain on landfills. Recycling, in particular, enables the reuse of materials, reduces energy consumption, and limits the extraction of raw resources. To enhance the waste disposal and recycling practices, it is found that the municipal assembly has been engaging the companies to ensure proper management of plastic waste management.

This is what a respondent indicated;

recently we had personnel from the Ga – South Municipality, Department of Environmental Protection Agency in our company, so they came there for inspection and also to engage us and also teach us more about how we can properly dispose our waste and then even further, how we can also in our small way start to recycle our own waste and then benefit the public as a whole.

The Department of Environmental Protection Agency personnel conducted an inspection and education session at our company. The purpose of their visit was to assess the waste disposal practices, educate participants on proper waste disposal methods, and encourage them to initiate recycling initiatives.

4.5 Key Supply Chain Challenges in Dealing with Plastic Waste Management.

Several challenges are being faced by companies engaged plastic materials in their operations. This section examines the challenges participants go through in their attempt to ensure plastic waste management.

4.5.1 Absence of local facility

The interviewees acknowledged the absence of a local facility for converting shredded plastic waste into new materials within the organization. This represents a significant challenge as it limits the organization's ability to achieve a closed-loop recycling system. However, it also presents an opportunity for future development. Establishing a local end conversion facility could not only support the circular economy but also provide economic benefits and job opportunities within the region. For instance, the Nigerian national team's jersey for one of the World Cups was made from PET plastic, showcasing an example of successful end conversion. However, it was noted that there is currently no local facility capable of performing the end conversion process.

4.5.2 One-Way Use of Pre-forms:

The statement emphasizes that the pre-forms used in the production line are not reused. This suggests that once the pre-forms are used to bottle the beverages, they are discarded as waste. It implies a linear approach to packaging, where the pre-forms are used for a single purpose and not recycled or reused.

4.5.3 Shortage in Waste Collection Industry

One of the significant factors contributing to delays in waste collection is the shortage of truck drivers in the waste collection industry. This shortage is a prevalent issue not only in Ghana but also in various parts of the world, including the United States. Factors such as an aging workforce, occupational danger, increased demand for trucking services, and low participation leading improper management of plastic waste.

This is comment from a participant;

um, sometimes the trucks that comes for the waste do not come like at the arranged time that they are supposed to come for, and then it makes it difficult to like gather it because, we don't really have enough space for the collection of the waste, so if they take long in coming for the waste, it, it is creates a problem for us because we have to force and somewhere to put other waste, we have to pay more things to keep those waste too, so yeah, I feel like that is the challenge that we are facing.

Another respondent also contended that;

.....you expect them to come in today to come and pick the waste they are not able and they will tell you that their trucks are not available or maybe they are at a certain condition, but within a week they will come and pick it, maybe the waste is a lot, maybe is not good for a factory or environment put up into the factory and this means there is no good

This indicates that one of the challenges faced by the company is the occasional delay in waste collection by the trucks responsible for waste disposal. These delays create difficulties in managing the waste effectively, as there may not be enough space to store additional waste until the trucks arrive.

4.5.4 Attitude of the General Public

The study found that the attitude of the general public towards waste management can indeed present a significant challenge. According to participants, despite the efforts to provide appropriate infrastructure, such as bins for plastic waste disposal, there are instances where people may disregard these facilities and choose to dispose of their waste inappropriately, such as on the

ground. This behavior can undermine waste management initiatives and contribute to environmental pollution.

One of the respondents was of the view that;

.....one of the key challenges is um, the attitude of the general public, no matter what you do, if the general public doesn't um cooperate with you, I can put a bin for you to put your plastic but you forget the bin and put it on the ground.....

Another participant concluded that;

.....so the challenges at the moment, is just with the mindset of the people who inside and appreciating that we have still our waste and the business will look at how much more we can generate from some of these things and addition to sustainability, um, like preserving the environment, so we look at those two aspect of it, how much in general we can preserve the environment and we do trainings from department to department just to bring that awareness to why people should segregate their waste just to protect um, the quality of the waste.

4.5.5 Challenges with Enforcement

The interviewees emphasized that enforcement is a significant issue in waste management, making it more expensive to handle waste. The need for someone to physically collect waste, which can often be dirty, adds to the cost and complexity of managing it. Additionally, the interviewees mentioned that recycling plastic requires washing it before the recycling process can begin, which further adds to the challenges faced in waste management.

A respondent's view;

.....and um, you know enforcement is also a big problem with this country, um, it makes it more expensive to manage the waste, because somebody has to come to pick, it might be dirty, before you can recycle, you have to wash it and so that is one of the problem, it is important that the general public cooperate with both the assemblies and waste management company and other service providers, so that we can have a sustainable um, um management practices for plastics and in waste in general.....

According to participants, to address these problems, the interviewee stressed the importance of cooperation between the general public, local assemblies, waste management companies, and other service providers. This collaborative effort is crucial for establishing sustainable waste management practices for plastics and waste in general. By working together, it becomes possible to find effective solutions and improve plastic waste management processes.

4.5.6 Financial Cost Involved

Based on the provided information, the interviewee highlighted the difficulties people face in supporting causes or initiatives due to financial constraints and the current global chaos. The interviewee expressed that the financial situation in the country makes it challenging for individuals to commit to support causes, as everything seems to revolve around cost.

This is a respondent's comment;

Is difficulty for people to support nowadays because everything has to do with cost, cost and the financial 'situation in the country right now is quite the global whole thing is just chaos, so is difficulty for people to commit to support.....

Another respondent also concluded that;

so our main problem here is financial problem because everything that we basically do involves money and then sometimes raising funds is not easy, since we are a private venture and then we do not get any support from the government, raising funds sometimes is a major problem because sometimes we have to um, call family members and friends for loans and grants and all that and then we find it difficult doing

The interviewees mentioned that the cost-driven nature of society, combined with the chaotic state of global affairs, creates obstacles for people to engage actively and support various endeavors. The financial situation in the country and the global challenge contribute to the difficulty in committing to support causes.

4.5.7 Cost in enforcing plastic waste management

The participants discussed two key challenges related to the enforcement of laws and by-laws at the assembly levels. The interviewees emphasized the significance of enforcing these regulations

to maintain order and prevent chaos within society. The participants stressed the need for enforcing most laws and by-laws at the assembly levels. This indicates that the focus is on local governance and ensuring that laws are applied effectively within specific regions or communities. The approach to enforcement at the assembly levels allows for tailored implementation based on the unique needs and circumstances of each area. However, this is not always achieved due to the cost involved.

This is what a respondent had to say;

and also it is important that we enforce most of the laws and even the by-laws at the assembly levels, we understand that the enforcement also comes as a cost, so it is important that we have a way to also um, support the assemblies to be able to play their role with the um, um, enforcing of these laws and making sure that people comply, I mean, um, the staff control the system otherwise we have chaos, and then the other, I mean these are lets say two challenges,

That is, enforcing laws comes with associated costs. This refers to the financial and resource implications of implementing and maintaining law enforcement mechanisms. The interviewee recognized that these costs should be considered and managed effectively to avoid undue burdens on the assemblies and their constituents.

4.6 The Regulatory Framework for Dealing with Plastic Waste in the Country

The interviewees mentioned several key documents, including the general company law, environmental management plan, environmental sanitation policy, and the constitution. This report will outline the significance and role of each document in guiding waste management practices within the country.

4.6.1 General Company Law

The general company law mentioned in the interview serves as the overarching legal framework governing various aspects of company operations, including waste management. While the specific details of this law may vary depending on the country, it typically outlines the legal obligations and responsibilities of companies in managing their waste and ensuring compliance with environmental regulations.

A respondent's comment;

.....the laws are, we have the general company law that govern um, um, Zoomlion, so the factories, the drains, um, before you construct the plant you have to do your EIA, um, have environmental management plan that is normal for every company, but within the environmental sector

It was indicated that before constructing a plant or any significant infrastructure, the interviewee mentioned the requirement of conducting an Environmental Impact Assessment (EIA). An EIA is a systematic process that evaluates the potential environmental effects of a proposed project. It involves assessing the project's impact on various environmental factors, including waste management practices, and identifying measures to mitigate any adverse effects.

4.6.2 Environmental Management Plan

The interviewees highlighted the necessity of having an environmental management plan in place for every company. An environmental management plan is a strategic document that outlines an organization's approach to managing and minimizing its environmental impact. It typically includes measures and procedures for waste management, pollution control, resource conservation, and compliance with relevant environmental regulations.

Respondent was of the view that;

.....I think article 44 or something the need to protect the public from um, consequence of environmental, bad environmental practices, these are all laws that governs the work that we do, we have laws on um, climate change that also um, um, guides the reason why we have to recycle plastics instead of turning them to generate a emission that can cause problems, so there are several number of laws, I just highlighted a few of them that actually governs the operations of um, a waste management company like Zoomlion Ghana.

4.6.3 Environmental Sanitation Policy

The interviewees mentioned an environmental sanitation policy that was initially established in 2019 and updated in 2020. This policy serves as a guide for waste management practices across the country, encompassing not only plastics but also all other types of waste. While it has not yet

been transformed into a law, this policy provides essential guidelines and standards for waste management, emphasizing the need for proper disposal, recycling, and environmental protection.

The respondents concluded that;

.....we have a policy that is not the environmental sanitation policy, that was done in 2019, was updated in 2020, that tells how um, um, waste has to be managed in the country, its yet to be transport into a law but this level it's a policy that guides how waste should be managed in the country, is not just for plastics, it's for all other waste, so these are the main guiding documents and the constitution, of the country has in it.....

The constitution of the country was mentioned as one of the guiding documents for waste management practices. While the specific provisions related to waste management may vary depending on the country, many constitutions include fundamental principles and rights related to environmental protection and sustainable development. These constitutional provisions lay the foundation for developing and implementing laws, policies, and regulations that govern waste management practices within the country.

4.6.3 National Plastic Action Partnership Initiatives

According to participants, the Ghana NPAP has launched the National Action Roadmap, which serves as an ambitious and locally designed plan to achieve zero plastic leakage into oceans and waterways by 2040. The roadmap was developed in consultation with 150 leading national experts and was informed by scenario analyses based on tools from the 'Breaking the Plastic Wave' report by the Pew Charitable Trusts. It outlines a strategic approach to radically reduce plastic pollution in Ghana and highlights the importance of collaboration across the plastic value chain to establish a circular economy. Under the realistic system change scenario, the country aims to reduce plastic leakage by 84% by 2040, while the ambitious system changes scenario targets zero plastic leakage

Respondent's View

.....so we are, we are very much aware of this career position but at the international level, there is an incoming treaty to manage plastics, we have also been contributing through a national platform that we call the "National Plastic Action Partnership", where all plastic stakeholders come together to see how we can address the issues of plastics

4.6.4 Contributions to International Efforts

The interview participants mentioned an incoming treaty at the international level to manage plastics. Ghana has been actively contributing to this global initiative through its involvement in the United Nations Environment Program (UNEP). The country has submitted a position in support of a legally binding framework that will help manage plastics internationally. By engaging in these international efforts, Ghana showcases its commitment to combating plastic pollution on a global scale.

This is participant's contribution;

.....and Ghana has submitted a position to see how it's under the United Nations Environment Program, that are looking, they are looking at legally binding framework to help manage plastics internationally and locally, so we are aware of these things

4.6.5 Public Awareness and Education Efforts:

Participants emphasize the significance of educating the public about plastic pollution and its environmental impact. They have been utilizing media channels, such as radio stations and TV stations, to intensify their efforts in educating the masses. On occasions like World Environment Day, they specifically focus on spreading messages about plastics and ways to reduce their consumption. By engaging with customers and raising awareness, the NPAP aims to encourage behavioral changes that contribute to the reduction of plastic pollution.

One of the respondents commented that;

we are contributing and we are also educating our customers, sending them messages on World Environment Day especially about plastics, these are all things that we doing within the radio stations and TV stations to intensify it

The interview with the participants highlights the country's commitment to addressing plastic pollution through a multi-stakeholder approach. Their efforts include a comprehensive National Action Roadmap to achieve zero plastic leakage by 2040, active participation in international treaty discussions, and ongoing public awareness and education campaigns. By engaging various stakeholders and implementing practical solutions, Ghana is making strides toward sustainable plastic management and environmental protection. However, it also highlights the little effort by

the various companies that use plastic materials in their operation and therefore requires attention to ensure its management.

4.7 Discussion of Result

Understanding the need for reverse logistics gaining weight in the wake of managing waste. In this regard the study analysed the approaches, the legislation, and the supply chain protocol as well as the challenges in management plastic waste in Ghana.

The result of the study showed that segregation and collection of plastic waste is one of the plastic waste management approaches in reverse logistics. The outcome of the study clearly depicts that the reverse logistics strategies start from its collection to segregation of plastic waste. This outcome is similar to the works of Prajapati et al., (2019); Agrawal et al., (2015) as they all revealed that reverse logistics involves a series of steps starting from identifying of waste, collection, segregation and recycling. The study also found that most of the companies that use plastic materials for their product have partnership with companies that engage in management of plastic waste in their operation. This result is consonant with reports from Tesfaye and Kitaw, (2021) and Mehmet Gu'1, (2016) as they all purported that reverse logistics plays a significant role in plastic waste management. In addition, the study found that some organizations are building recycling system to do the collection and recycling of product. This approach is also supported by the works of Tesfaye and Kitaw, (2021) and Mwanza et al., (2018) with view that post-consumer recycling procedures include collecting, classifying, of these plastic materials with a well-structured system.

The study also found that reverse logistics from this approach tends to reduce the cost incurred in purchasing of plastic materials for their product as they tend to send the plastic waste to recycle companies and in turn, they get discount for purchasing the plastic materials. This is a revelation that was found in the study and was recognized as a strategy to plastic waste management. This could be referred to the report of (Banadda et al., 2019; Ebenezer and Sun; Okwu et al., 2021; Fikru, 2020). It was found that once the remanufacturing process is complete, the supplier offers the remanufactured preforms back to the companies at a discounted price. This incentivizes them to purchase these preforms instead of new ones, leading to cost savings for the company. Thus, there is a conversion of materials into other products as it was found in the study as purported by Matiws (2014).

In examining the role of supply chain members in plastic waste management, the study found that members in the supply chain process have relationships and networks to ensure that, there is flow of materials and plastic waste for effective management. The result of the study showed a steady collaboration with other waste management organisations in the supply chain for plastic waste management. This result clearly depicts the work of Afum et al., (2021) as they concluded that producers, vendors and transport companies must work together to ensure effective plastic waste management practices. The study reviewed that to determine economic sustainability of the recovery system collaborative efforts is needed from members in the supply chain as the process could be very expensive. This clearly support the findings from Jindal & Sangwan (2015) as they claim recovering returned goods calls for an effective and efficient collecting strategy as the recovery process activities may be economically viable but the entire business might be expensive due to high collection cost. The study further revealed that companies selected have close contact with their vendors and client to recollect their plastic materials for reuse. This approach tends to promote plastic waste management and save cost. This report meets the work of Grabara et al., (2014) indicating that there is cost effective in engaging all supply chain members on reverse logistic strategy. The study also revealed that there is a production cycle where several organisations are involved to ensure effective proper supply chain process that brings about effective waste plastic management. The result supports the view of Debe & Omar (2020) as they concluded that several supply chain members are needed to ensure proper collection, cleaning and recycling of plastic waste management.

Another area of focus for the study was the challenges in plastic waste management. The study found that technical challenges are one of the key problems faced by the companies in dealing with plastic waste. It was reviewed in the study that there is absence of local facility for converting shredded plastic waste into new materials within the organization. This represents a significant challenge as it limits the organization's ability to achieve a closed-loop recycling system. The outcome of the study was consistent with the work of Satapathy (2017) and GoPigeon (2016) as they concluded that limited facilities prevent the plastic waste management. This further is related to the work of Amico (2021) and Natarajan (2022) with the view that lack of technical expertise limits the progress in achieving plastic waste management, nevertheless it also presents an opportunity for future development. Establishing a local end conversion facility could not only

support the circular economy but also provide economic benefits and job opportunities within the region. showcasing an example of successful end conversion.

Another challenge was the cost involved when companies choose to enter reverse logistic. The outcome supported by Kosacka (2020) and Amico (2021) as they all were of the view that financial challenges prevent companies that engage in plastic materials to adopt plastic waste management practices. The study is also in support of the work of Amico and Mwanza and Mbohwa (2017) as they purported that lack of public concerns and attitude creates a huge challenge to plastic waste management. Reinforcing the rules governing plastic waste management was also found to be a hinderance due to cost burden on government. This relates to a report of Milios et al., (2018) with the view that enforcing the laws and regulations to plastic waste management requires financial prowess and this tends to pose a challenge to most local authorities.

The final objective was on the regulatory framework in plastic waste management. The study was of the notion that several laws govern the plastic waste management in Ghana. They include the company law that governs companies in ensuring the management of plastic. There is also Environmental management plan, environmental sanitation policy, and National Plastic Action Partnership Initiatives. All these are formulated to provide guidelines and approaches in meeting the strategic management of plastic waste. These regulations are related to international regulation by the OECD report in 2016 and Plastic Waste Control Plan.

Despite the efforts of companies to promote plastic management, there is lack of expertise and financial commitment to ensure the reduction and management of plastic waste. There are regulations and frameworks to govern the management, however, there is lack of enforcement to achieve plastic waste management.

CHAPTER FIVE

SUMMARY CONCLUSION AND RECOMMENDATIONS OF FINDINGS

5.0 Introduction

This chapter focuses on the summary of findings from chapter four. It then provides conclusion to the outcome of the study, then, finally suggests recommendations to the study.

5.1 Summary of Findings

The study considered various topics ranging from companies' profile, the typed of plastic materials companies engage in, the reverse logistics strategies adopted by companies, the supply chain process and how that benefits plastic waste management, the challenges companies, and other stakeholders face in management of plastic waste and the policy and regulatory tools that govern plastic waste management in Ghana.

In terms of the companies' information, the study found that three institutions were organisations that use plastic materials in packaging their products whereas one was a waste management organisation. Out of the four institutions, twelve participants were selected to be part of the study. On the kind of plastic that organisations used for their production, the study found that the participants acknowledge the presence of plastic waste originating from the bottles and rolls used in sachet production. Sachet water is typically packaged in thin plastic sachets made from materials like polyethylene or polypropylene. These materials are not easily biodegradable, leading to long-lasting environmental pollution when improperly disposed off. One of the companies mentioned that only one product is produced in plastic bottles whiles other products are packaged in glass bottles.

In terms of reverse logistic strategies in plastic waste management, the study found that different types of plastics require different technologies for effective management. Once segregated by type, the plastics are further sorted based on their polymer composition. The companies selected indicated that they have established a partnership with a waste management company to effectively manage its production waste. The primary objective is to ensure responsible disposal and recycling of the waste materials. It was also revealed that some of the organizations currently have a sustainable waste management practice in place. They have collaborated with an entity that collects the waste generated by the organization: they however do not involve in the recycling of

the waste as most of their preforms are one-way use. The study revealed that after segregation by type by the waste management company the plastic waste, particularly polyethylene terephthalate (PET), undergoes a shredding process leading to recycling. The study also found that some companies have integrated production system enables greater control and efficiency throughout the manufacturing process and the management of plastic especially during the formation of the Pre-forms.

The second objective of the study identify the role of supply chain members in plastic waste management. The outcome of the study showed that adopting a reverse logistics approach within the sanitation value chain ensures that responsible systems are in place to handle waste materials. it was mentioned that some of the companies have an arrangement with disposal agencies such as Zoomlion for waste management. This arrangement ensures the proper disposal of the company's waste materials, particularly the packaging waste. The study also found that some the organizations collect the empty bottles, washes them thoroughly, and refills them. Once refilled, the organization supplies the bottles back to the client for continued use. This according to the approach leads to the management of plastic waste. The study found that by collecting glass bottles found in public spaces, some of the organizations aim to prevent them from becoming waste and instead reintroduce them into the production cycle. The study found that most of the companies operate through a well-established network of distributors, wholesalers, and retailers. This structure allows for efficient distribution and widespread availability of their products. Also, according to participants, distributors are not authorized to dispose of problematic products themselves. This measure is implemented to prevent improper disposal methods that may negatively impact the environment or the company's reputation. To enhance the waste disposal and recycling practices, it is found that the municipal assembly has been engaging the companies to ensure proper management of plastic waste management.

The study also explored the supply chain challenges in dealing with plastic waste management. The result of the study showed that the absence of a local facility for converting shredded plastic waste into new materials within the organization. The study also found that one of the significant factors contributing to delays in waste collection is the shortage of truck drivers in the waste collection industry. According to participants, despite the efforts to provide appropriate infrastructure, such as bins for plastic waste disposal, there are instances where people may

disregard these facilities and choose to dispose of their waste inappropriately. The interviewees mentioned that recycling plastic requires washing it before the recycling process can begin, which further adds to the challenges faced in waste management as appropriate infrastructures need to be in place. Also, the interviewee expressed that the financial situation in the country makes it challenging for individuals to commit to support causes, as everything seems to revolve around cost. Another challenge found was the lack of enforcement due to cost and unwillingness of people.

The final objective of this work was the regulatory framework for dealing with plastic waste in Ghana. According to participants the general company law mentioned in the interview serves as the overarching legal framework governing various aspects of company operations, which include waste management. Also, the interviewees highlighted the necessity of having an environmental management plan in place for every company. According to participants, the Ghana NPAP has launched the National Action Roadmap, which serves as an ambitious and locally designed plan to achieve zero plastic leakage into oceans and waterways by 2040. According to respondents Ghana has been actively contributing to global initiative through its involvement in the United Nations Environment Program (UNEP) that aim at managing plastic waste. Participants emphasize the significance of educating the public about plastic pollution and its environmental impact. They have been encouraged to utilize media channels, such as radio stations and TV stations, to intensify their efforts in educating the masses.

5.2 Conclusion

The study generated key approaches organizations used in plastic management. Some challenges were also identified and regulatory frameworks that ensures the protection of the environment through plastic waste. The study suggests the plastic waste management through reverse logistics is an essential component of addressing the environmental challenges posed by plastic waste. In essence, by integrating reverse logistics into the sanitation value chain, producers can ensure that waste materials are managed responsibly, reducing environmental impacts and promoting sustainability. It was discovered that this approach could be possible when there is supply chain members in the process to aid in plastic waste management. This plastic management was however found to have challenges. This study recognizes the existence of various policy regulations; however, the enforcement of the regulations seems to have some challenges. The study therefore provides some recommendations for addressing the outcome of the study.

5.3 Recommendation of the Study

Recommendation for Management

Effective management of plastic waste is crucial for environmental sustainability and the circular economy. Reverse logistics plays a vital role in the collection and recycling of plastic waste, enabling it to be reused and repurposed. As such, the following provides recommendations for implementing reverse logistics strategies in plastic waste management:

There should be regular monitoring and evaluation of the performance of plastic waste management initiatives within the supply chain. Key performance indicators (KPIs) can measure recycling rates, waste reduction targets, and overall environmental impact. Analyzing data and feedback can help identify areas for improvement and guide future sustainability strategies.

It is also key for companies to embrace the principles of the circular economy to design and implement reverse logistics strategies. The circular economy focuses on reducing waste generation and maximizing resource utilization through recycling, remanufacturing, and refurbishing. By adopting circular economy principles, companies can enhance the performance of their plastic recycling systems and promote the active involvement of various stakeholders, including plastics producers, users, municipalities, and recyclers.

There is the need for companies and state authorities to identify and address the barriers that hinder the effective implementation of reverse logistics for plastic waste management. These barriers may include lack of awareness, inadequate infrastructure, insufficient incentives for stakeholders, and limited cooperation among industry players. Overcoming these challenges requires collaborative efforts from governments, businesses, and communities to create supportive policies and infrastructure for plastic waste collection and recycling. There is the continual need to educate the public about plastic pollution and its environmental impact through the media channels, such as radio stations and TV stations.

The study suggests that management should promote sustainable practices in reverse logistics, such as recycling, refurbishing, and reusing returned products. Companies can establish partnerships with recycling facilities and invest in facilities for plastic waste processing. Emphasize eco-friendly packaging to reduce the environmental impact of plastic waste, and

encourage customers to participate in recycling programs by offering incentives and educational campaigns.

Raising public awareness about the importance of recycling and the proper disposal of plastic waste is key. Thus, authorities should educate consumers about the environmental impact of plastic waste and the benefits of participating in recycling programs. Engaging the public and creating a culture of responsible waste management can significantly increase the success of reverse logistics initiatives in plastic waste management.

It also recognises the supply chain disruptions related to plastics, such as shortages in trucks and price increases, underlines the importance of building resilient supply chains. Government and other key stakeholders must invest in industries needed to supply vehicles needed for the collection of waste.

It was noted that there is currently no local facility capable of performing the end conversion process. Supply chain members should take responsibility for the proper disposal and end-of-life management of plastic products. Implementing effective take-back programs, partnering with recycling facilities, and ensuring proper waste treatment are essential steps to reduce plastic pollution and environmental harm.

The study also recommends that companies should improve plastic waste management. Supply chain members should collaborate and establish partnerships along the value chain. Close cooperation between suppliers, manufacturers, retailers, and waste management facilities can facilitate the efficient collection, recycling, and repurposing of plastic waste. Joint solutions and shared responsibilities can lead to a more effective and sustainable plastic waste management system.

Policy Direction

The study recommends that it is essential to develop a comprehensive framework that considers the entire lifecycle of plastic waste. This framework should encompass all stages, from the initial collection to the final recycling or disposal. The current disposal operation utilized by the country is mostly land filling and incineration; these need to be regulated to reduce their negative impact on the environment. Including the most critical issues and factors in the framework will enhance

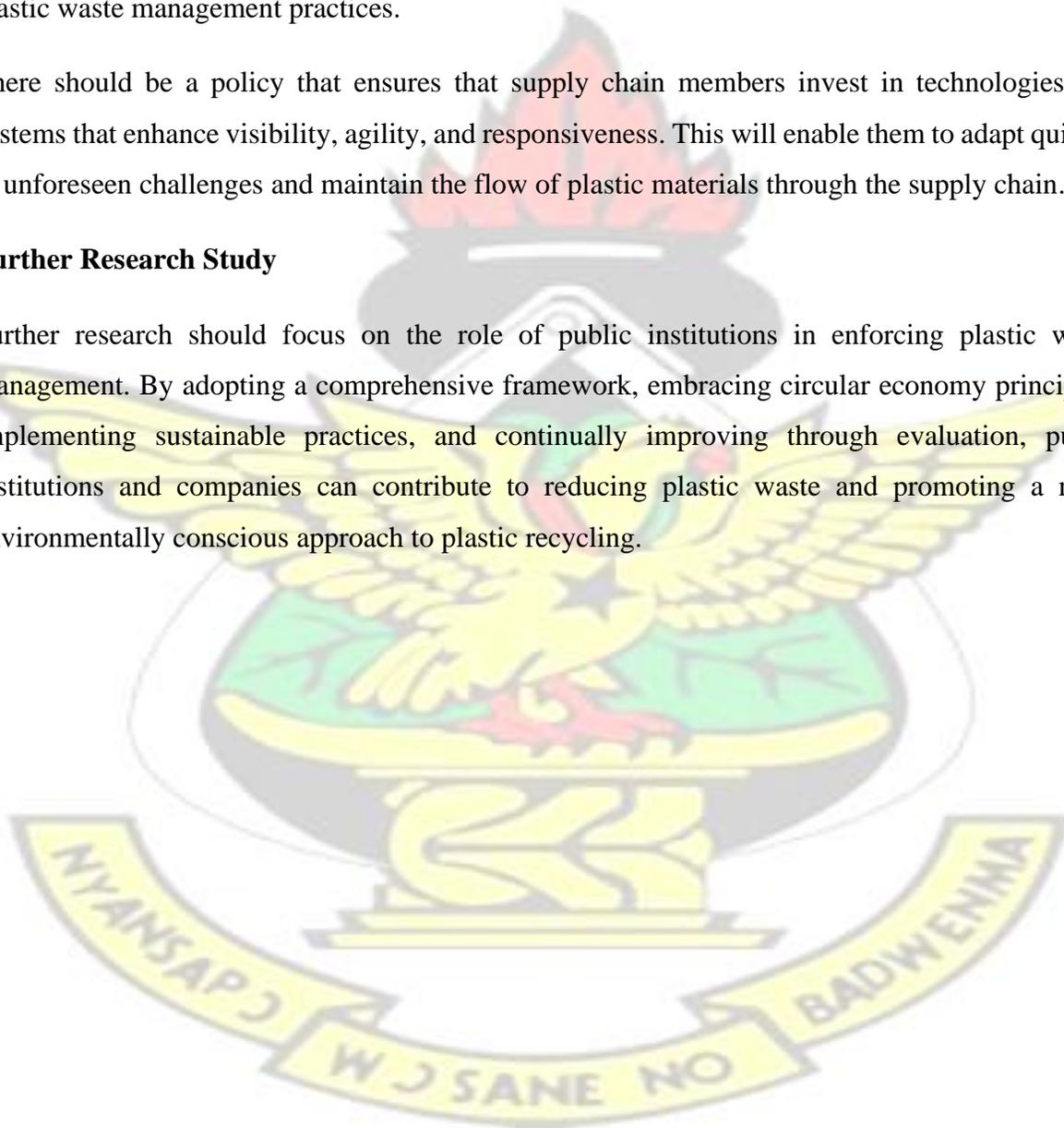
the success of reverse logistics implementation. The framework should be further validated through empirical studies in the plastics sector to ensure its practical relevance.

Also, there should be regular evaluation of performance of reverse logistics strategies to identify areas for improvement. Use key performance indicators (KPIs) such as collection efficiency, recycling rates, and cost-effectiveness to measure the success of the implemented strategies. Continuous improvement based on data-driven insights will lead to more efficient and sustainable plastic waste management practices.

There should be a policy that ensures that supply chain members invest in technologies and systems that enhance visibility, agility, and responsiveness. This will enable them to adapt quickly to unforeseen challenges and maintain the flow of plastic materials through the supply chain.

Further Research Study

Further research should focus on the role of public institutions in enforcing plastic waste management. By adopting a comprehensive framework, embracing circular economy principles, implementing sustainable practices, and continually improving through evaluation, public institutions and companies can contribute to reducing plastic waste and promoting a more environmentally conscious approach to plastic recycling.



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APPENDIX

MANAGING PLASTIC WASTE THROUGH REVERSE LOGISTICS IN SOME SELECTED COMPANIES IN ACCRA

Interview Guide for Companies

Name of Company:

Name of Respondent:

Designation:

Contact:

Email Address:

BASIC INSTITUTIONAL INFORMATION

1. How long has the company been in existence?
2. What is the total number of employees, including management staff and non-management staff?
3. What operations or departments exist to ensure the smooth running of the company?

REVERSE LOGISTICS STRATEGIES

1. What kind of plastic waste are produced from your production to distribution?
2. What measures are in place to manage plastic waste?
3. What is your organization's understanding of the concept of reverse logistics and its relevance to you organisation?
4. Which processes do your organization follows regularly during the implementation of reverse logistics practices?
5. What activities can we consider in Reverse Logistics process to improve the Supply Chain operations, specifically in your company?
6. How does the company inspect/select and sort products (plastics) for further processing?
7. What is your organisation decision on remanufacturing/recovering of plastics for production?
8. Can you provide a brief description of the financial allocation for practicing of reverse logistics?

9. What processes are used by your organisation to ensure proper disposal and collection of used plastic bottles in order to protect the environment and to make plastic bottles as a source of income?
10. What awareness are being created by your organisation within the society about proper disposal and management of after consumption plastic bottles?
11. What is your organization's relationship with stakeholders (city administration, waste collection companies) in plastic waste recycling collection in order to improve /expand the reverse logistics activity?
12. What design and standard of materials does your organisation have for the purpose of reuse of plastic waste?
13. What efforts has your organisation made towards the implementation of reuse of the plastic bottles?
14. Which technologies are used in the process of recycling plastic waste products by your organisation?
15. What are the major challenges faced by your organisation during plastic waste management and the use of reverse logistics approach to manage it?
16. What is your plan in relation to reverse logistics practice?

SUPPLY CHAIN MEMBERS

17. How does your organisation manages' institutions or companies involved in the processes below:
 - 18a. Plastic products manufacturers
 - 18b. Distributors
 - 18c. Consumers
 - 18d. Plastic waste collectors
 - 18e. Plastic waste recyclers
 - 18f. Any other, please provide

SUPPLY CHAIN CHALLENGES

18. What challenges does your organization faces in dealing with the following areas of supply chain during reverse logistics of plastic waste:
- 19a. Plastic products manufacturers
 - 19b. Distributors
 - 19c. Consumers
 - 19d. Plastic waste collectors
 - 19e. Plastic waste recyclers
 - 19f. Any other, please provide

REGULATORY FRAMEWORK

19. What is your organization's principle to waste management?
20. What is your organization's principle to environmental protection?
21. Are your organization's environmental policies and actions aligned with minimizing the impact of after use plastic wastes to the environment?
22. What is your organization's principle to social responsibility?
23. Which institution(s) regulate the management of plastic waste in your organisation?
24. How is your organisation complying with regulations on plastic waste management by EPA and FDA?

**MANAGING PLASTIC WASTE THROUGH REVERSE LOGISTICS IN SOME
SELECTED COMPANIES IN ACCRA**

Interview Guide for Waste Management Companies

Name of Respondent:

Designation:

Contact:

Email Address:

1. How long has the organisation been in existence?
2. What is your organisation's mandate?
3. What is your organisation's view on plastic waste management?
4. What is your organisation's view on reverse logistics in plastic waste management?
5. Explain the regulatory framework guiding plastic waste management?
6. What are the challenges in plastic waste management?
7. How does the organisation regulate manufacturing companies in dealing with plastic waste management through reverse logistics?
8. How can we improve plastic waste management through reverse logistics?

