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| Research Project Title: Developing the Circular Plastic Economy in Nigeria: An Analysis of Capacity-Building Initiatives |
| Module Code: ENGT 5304\_2223\_519 |
| Module Title: Dissertation |
| Programme: M.Sc. Engineering Management |
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## DECLARATION

I hereby declare that this project titled "Developing the Circular Plastic Economy in Nigeria: An Analysis of Capacity-Building Initiatives" is a product of my original research work. All sources of information, data, and literature that have been used or referred to during this study have been duly acknowledged. This work, in its entirety or in part, has not been submitted for any degree or examination at any other institution.

I confirm that the research adhered to ethical research guidelines and no data was fabricated or manipulated to support the findings.

Any findings, conclusions, or recommendations expressed in this material are mine and do not necessarily reflect the views of any affiliated institution or organization.

# ACKNOWLEDGEMENT

I would like to express my heartfelt gratitude to individuals who have played pivotal roles in the completion of this work.

First and foremost, I owe a debt of gratitude to my parents, Elder David Oke and Deaconess Olusola Oke, whose boundless love, sacrifice, and unwavering belief in my potential have been the driving force behind my academic pursuits. Your constant encouragement, wise counsel, and unflagging support have been my pillars of strength.

I extend my sincere appreciation to my supervisor, Dr. Muyiwa Oyinlola, for his invaluable guidance, mentorship, and expertise throughout this research project. Your dedication to my academic growth and your commitment to excellence have been instrumental in shaping the quality of this work.

I am also indebted to my friends and colleagues who provided moral support, insightful discussions, and a sense of camaraderie during this challenging journey.

This work stands as a testament to the collective efforts and support of all these individuals, and I am deeply grateful.

# ABSTRACT

This research study was conducted with the primary objective of assessing the significance of capacity-building initiatives in propelling the development of a circular plastic economy within the Nigerian context. To achieve this objective, an exploratory research design was adopted, coupled with qualitative secondary data collection methods. This approach relied on the comprehensive analysis of previously published articles sourced from peer-reviewed journals, newspapers, and various reputable publications to extract valuable scientific evidence and insights. Furthermore, this study employed a multiple case study approach to delve into the intricacies of the subject matter. The selection of case studies was carried out through non-probability sampling techniques, specifically convenience sampling, in order to ensure practicality and accessibility for the research.

The findings gleaned from this study revealed a significant aspect of the circular plastic economy in Nigeria, which is still in its nascent stages, mirroring the developmental trajectory observed in other emerging economies. The core focus of this research revolved around three pivotal capacity-building initiatives: plastic collection and recycling, conversion of plastic waste into energy, and consumer education and training. In summary, this research underscores that while the circular plastic economy is still in its infancy within Nigeria, it aligns with the developmental trajectories observed in other emerging economies. The capacity-building initiatives of plastic collection and recycling, conversion of plastic waste into energy, and consumer education and training, which have proven to be catalysts for circular plastic economies in developed nations, were assessed for their applicability within the Nigerian context and found to be suitable. These findings pave the way for future endeavors aimed at advancing sustainability and responsible plastic management practices in Nigeria.

**Keywords:** Circular plastic economy, capacity building initiatives, plastic collection and recycling, consumer education and training, plastic waste to energy.

# CHAPTER ONE

# INTRODUCTION

## Background

Worldwide, a huge amount of plastic is produced (Geyer et al., 2017), as a result of its significant effect on environmental sustainability and global economic development. For instance, it helps to increase the shelf life of food items because of its use as a packaging material, thereby reducing food waste effectively (Barlow and Morgan, 2013). Although the use of plastic in products and packaging comes with many economic and societal benefits (Gritzmann, 2018; Johansen *et al.,* 2022), the traditional/current linear economy characterized by a “produce, use, and dispose model” has been determined to be the main source of greenhouse emissions and environmental pollution (European Commission, 2018; Hahladakis *et al.,* 2018).

Over the past five decades, there has been a significant amount of plastic waste produced due to the intense increment in the production of plastic globally (Gu and Ozbakkaloglu, 2016). This waste poses significant environmental and social challenges due to the presence of numerous highly toxic trace elements in its pigment (Gondal and Siddiqui, 2007), which has consequently become a matter of concern on a global scale, necessitating urgent attention and action to address its adverse impacts.

By putting an emphasis on reducing, reusing, and recycling plastics throughout their existence, the idea of a circular plastic economy provides a comprehensive solution to this problem (UNIDO, 2017). The Circular Economy (CE) has been pushed forward as the solution to the numerous problems associated with plastics and their use (Knäble, *et al.,* 2022). Such an economy strives to minimise waste production, increase resource efficiency (EEA, 2020; Velenturf and Purnell, 2021), and lessen the environmental effect (Wamba, *et al.,* 2023) connected to the consumption and disposal of plastic.

Nigeria, the nation with the largest population in Africa (Kamar, 2023), struggles a substantial amount of plastic waste production, particularly in urban regions (Akinwale, 2019; Duru, *et al.,* 2019). There is a lot of plastic pollution in the environment, which has impacted both terrestrial and aquatic ecosystems negatively (Henderson and Dumbili, 2021), due to the country`s dependence on plastics for packaging and ineffective waste management techniques (Ayodele, 2022; Anichebe, 2019). A well-organized circular plastic economy becomes essential, to address these issues.

Nigeria, is also not prepared to transit to a circular economy; as a report by Duru, *et al.,* (2019) states that there is a little amount of information concerning the use and waste management of plastics which may be said to be the reason for the sluggishness in creating and implementing strict policies for plastic waste management. This is dangerous for the country as it leads to flooding, loss of lives and properties, etc. (Ayodele, 2022). This study examines capacity-building measures that could lead Nigeria towards a sustainable plastic management structure in the context of developing a circular plastic economy. In this introductory section, the context of the research, problem statement, justification, aim and objectives, scope and significance, as well as the structure of the dissertation, are all briefly described.

* 1. Justification

The justification for this research arises from the serious environmental and economic problems that Nigerian plastic waste presents, which needs to be addressed urgently. The linear plastic economy, which is defined by the manufacture, use, and disposal of plastic products, has resulted in serious environmental damage, including the obstruction of waterways, the destruction of natural ecosystems, and adverse effects on human and animal health especially the aquatic environment. Nigeria has to rapidly make the transition to a more sustainable and circular plastic economy because it is one of Africa's largest producers of plastic waste. This study will then examine the circular plastic economy model, which attempts to minimise waste creation, decouple plastic production from the use of fossil fuels, and encourage the reuse, recycling, and proper disposal of plastic materials. With reference to the adoption of circular plastic economy practices by companies in Nigeria, the case studies to be utilised in this study, provides insightful information. Through the development of new business prospects in the circular plastic economy sector, this research study will play a critical role in promoting sustainable plastic management practices, fostering environmental conservation, and promoting economic growth.

It is necessary to analyse current Nigerian laws/policies and skills that aid the development of the circular plastic economy in Nigeria to answer the research question(s) posed in this study. Better education and training systems ought to be created to fulfill the requirements of the Circular Plastic Economy in Nigeria by reviewing the existing skills and finding improvement opportunities. The study attempts to link existing knowledge and skills with the essential knowledge and skills to support the success of the Circular Plastic Economy in Nigeria by identifying barriers like insufficient financing or regulations.

## Research Aim and Objectives

### 1.3.1 Research Aim

The main aim of this research is *to critically analyse how capacity-building initiatives in Nigeria may be implemented to develop a circular plastic economy*.

These initiatives will be drawn from what is currently attainable or in developmental stages as a blueprint for the circular economy in Nigeria. Therefore, this study is posed to answer the following specific question:

How can capacity-building initiatives help to develop the circular plastic economy in Nigeria?

### 1.3.2 Research Objectives

1. To evaluate the current state of Nigeria’s plastic waste management system.
2. To identify important stakeholders and their functions in advancing a circular plastic economy.
3. To assess effective regional and international cases of capacity-building programmes for managing plastic waste.
4. To develop recommendations for specialised capacity-building plans that are in line with Nigeria's socioeconomic circumstances.

## Significance of study

There are a number of important implications involved in this research and they include: **Environmental Impact**: The study can find ways to mitigate the negative effects of plastic waste on the environment, by examining the transition towards a circular plastic economy, which will minimize pollution, enhance waste management techniques, and preserve natural ecosystems.

**Economic Growth and Job Creation**: By recognizing the advantages of a circular plastic economy, new businesses and sectors may arise, generating employment opportunities, reducing vices in the nation and aiding in the growth of the nation’s economy.

**Policy Development**: The results of this research can help Nigerian decision-makers create effective policies to advance the circular plastic economy. These regulations can help promote responsible plastic management, generate financing, and direct the creation of helpful legislative frameworks.

## 1.5 Scope of the Research and its Limitations

This study will focus on multiple capacity-building initiatives and what the objectives of the company implementing them are, to manage the plastic waste situation in Nigeria. The research will include an assessment of the current plastic waste management system, identification of stakeholders, and an exploration of the challenges and opportunities related to adopting circular plastic economy practices. While the findings from the case studies can provide valuable insights, it is essential to acknowledge some limitations of this research, which include:

1. Time constraints: Due to the short period of time allotted to the completion of the study, it restricts an in-depth analysis of all aspects of the circular plastic economy, and some relevant factors might not be thoroughly explored.
2. Data Collection: A major limitation to this study is the unavailability of the researcher on the field, to gather and collect data from various stakeholders in the plastic economy on subjects such as management practices and long-term impacts of circular plastic economy initiatives.
3. Generalisability: The results of this study may not be entirely representative of all regions/companies in Nigeria due to variations in infrastructure, demographics, and waste management systems.

Despite these limitations, the study endeavors to provide valuable insights into the potential for building capacity for the circular plastic economy in Nigeria, promoting sustainable plastic management practices, and fostering a transition towards a more environmentally conscious and economically viable approach to plastic waste.

# CHAPTER TWO

# LITERATURE REVIEW

## 2.1 Concept of plastics and its lifecycle

Plastics are a fundamental part of our modern world, deeply integrated into various aspects of our daily lives. Over the years, the rate of production of plastics has increased. This eruption in the rate of consumption and production of plastics can be attributed to the increase in the world’s population from 2.5 Billion to about 7.7 Billion since 1950, hence, the knowledge of plastic production is a forerunner of the exploitation and use of plastics globally. Their widespread use is attributed to a combination of unique properties that make them an ideal choice for a multitude of applications (Bucknall, 2020). Beyond their affordability, plastics possess a remarkable combination of characteristics such as lightness, malleability, chemical inertness, water repellency, and remarkable durability (Bishop *et al.,* 2020). These attributes enable their incorporation into numerous industrial processes, the creation of diverse products, and the development of efficient packaging solutions. Additionally, plastics exhibit exceptional thermal and electrical insulation properties (Heller *et al.,* 2020), further expanding their utility in a wide range of industries, from electronics to construction.

The concept of plastics and their lifecycle encompasses a complex journey that begins with the extraction of raw materials, usually derived from fossil fuels such as oil and natural gas. These raw materials are then subjected to intricate chemical processes to create polymers, the building blocks of plastic materials. Once manufactured, plastics serve various purposes, contributing to a significant portion of consumer goods and packaging materials. However, the widespread reliance on plastics has given rise to a pressing environmental concern: plastic pollution.

One of the most challenging aspects of plastic pollution is the inherent resilience of plastic polymers. Unlike many natural materials, plastics take an extraordinarily long time to decompose. Depending on the type of plastic and the environmental conditions it is exposed to (Thompson et al., 2004; Verma et al., 2016; Xanthos and Walker, 2017), degradation can take anywhere from hundreds to thousands of years (Pol and Thiyagarajan, 2010). This longevity results in the accumulation of plastic waste in ecosystems, from terrestrial environments to the farthest reaches of the ocean.

Over time, the degradation of larger plastic items, often exacerbated by sunlight and other environmental factors, leads to the formation of smaller fragments known as microplastics (Boucher and Friot, 2017). These microscopic particles are virtually invisible to the naked eye, yet their impact on ecosystems is far from negligible. Microplastics present numerous threats to both wildlife and human health. Marine life, in particular, is susceptible to ingesting these particles, either directly or indirectly through the food chain. The consequences of ingestion can be dire, ranging from physical harm due to blockages or damage to the digestive system, to toxicological effects caused by the release of harmful chemicals contained within the plastics (Free, *et al.*, 2014; Lusher, *et al.,* 2015). These harmful effects can disrupt entire ecosystems, with potential ripple effects on both biodiversity and human livelihoods (Lamb, *et al.,* 2018).

Recognizing the urgency of the situation, efforts to address plastic pollution have gained traction on a global scale. Initiatives range from innovative recycling technologies and materials engineering aimed at creating more sustainable plastics, to policy changes that aim to reduce plastic consumption and improve waste management practices. The implementation of circular economy principles, which emphasize recycling, reusing, and reducing plastic waste, is a crucial step toward mitigating the negative impact of plastics on the environment.

Summarily, the concept of plastics and their lifecycle is closely intertwined with the challenges posed by plastic pollution. While the versatility and usefulness of plastics have revolutionized various industries, their persistent nature and widespread pollution have given rise to a pressing environmental crisis. Addressing this issue necessitates a comprehensive approach that encompasses technological innovation, policy reform, public awareness campaigns, and international collaboration, all aimed at curbing the detrimental effects of plastic pollution on ecosystems and human well-being.

## 2.2 Analysis of Nigeria’s current Plastic Waste situation

As the most populated nation with the largest GDP in the African continent, Nigeria shares the plastic problem with its increasing consumption from 578,000 tonnes of plastics in 2007 to about 1,250,000 tonnes in 2017 in the country. Per capita plastic consumption has grown by 5% annually from 4.0kg to 6.5kg respectively. It is estimated that each citizen would consume 7.5kg of plastics per year by 2020. In Nigeria, it is estimated that plastic accounts for 13% of total solid waste. The country is ranked as the 9th top country out of 192 countries having coastlines generating mass of mismanaged plastic waste by the population living within 50km of the coast, accounting to 0.85 million metric tons, or 2.7% of global mismanaged plastic waste (Jambeck et al., 2015). It is forecasted that Nigeria will be the nation producing the largest volume of mismanaged plastic waste in African continent by 2025 (UNIDO, 2021).

Plastics are a derivative of polymers of high molecular mass and they are usually considered recyclable (Babayemi *et al.*, 2019). In Nigeria, a large amount of low-density polyethylene has been brought into the country in the past 20 years, which has been used to make a several plastic items, which include nylon bags, supermarket bags, cling wrap, sandwich bags, bubble wrap, fertilizer sacks, trash bags, and plastic bottles. But more frequently, these used just singly before they are being discarded (Babayemi, *et al.,* 2018) (Mwanza, *et al.,* 2018)

In Nigeria’s packaging sector, the use of plastic has been the major material which estimates to an approximately 30% volume of plastic packaging waste generation (Patel, *et al.,* 2000). Half the number of total plastic wastes in general follow the linear economy of plastic waste, which includes single-use, then disposal of these product. Although this waste generation and disposal statistics may vary from one nation to another (Hopewell, *et al.,* 2009).

These massive production with poor management is the major state the Nigerian waste management is in. with the growing population and little or no improvement in the circular economy. Inadequate collection channels, the poor disposal practices of the citizens and insufficient recycling infrastructure, have all contributed significantly to the challenges that Nigeria battles in the management of plastic wastes. These significant challenges have produced disastrous effects such as, degradation of the environment and not the preservation, health risks and hazards including a wide range of medically important diseases, economic crisis leading to devaluation of the country’s economy. A lot of factors have contributed to this poor state of the country’s poor management situation. To mention a few, bad government policies, unavailability of proper waste disposal channels, indiscipline and generally illiteracy among the citizens and the linear pattern of waste disposal generally due to low number of recycling companies.

### 2.2.1 Plastic Waste production and consumption statistics

From 1964 to 2015, the manufacturing of plastics increased twenty-fold, culminating in an annual output of 322 million metric tonnes. According to projections, this output will double by 2035 and nearly quadruple by 2050. In the context of the nation Nigeria, the plastic waste situation is not any different.

Despite being the only resin producer in the West and Central Africa region, Nigeria paradoxically relies on imports of plastics, primarily made from oil (naptha) in its raw form. The country produced 486 kt of resin (325 kt PE, 96 kt PP, 65 kt PET) in 2018 and 498 kt of resin (322 kt PE, 101 kt PP, 75 kt PET) in 2019 (WACA, 2020). While being a net importer of resin, Nigeria is the largest producer of olefins and polyolefin plastics in West Africa, with Indorama Eleme Petrochemicals Limited leading the sector. With over 3,000 plastic companies, Nigeria produces various products, including jerry cans, shopping bags, tables, and mats (Obioha, 2019). In 2019, plastic imports into Nigeria amounted to $1.7 billion, encompassing all key plastics resins (PE, PP, polystyrene [PS], and PVC). This high demand for primary plastics (resins) has fostered a robust plastic manufacturing sector, with production growing at a rapid rate of 13.9 percent annually, from 120 kt in 2007 to a projected 513 kt in 2020, according to market reports.

The management of plastic waste in Nigeria has become a great challenging issue as a result of the country's rapid population growth, urbanization, and increasing plastic product usage. According to estimates made by Statista (2023), as of 2020, Nigeria was already producing about 513,000 tons and consuming over 1.5 million tons of plastic. However, in 2023, the situation has worsened, with Nigeria generating approximately 2.5 million tonnes of plastic waste annually (Uwaegbulam, 2023). Plastic accounts for 15 percent of the total waste generated in Lagos alone, with about 9,000 metric tons of waste generated daily, and a staggering 86 percent of that waste consists of plastic bottles and bags, as reported by The Lagos State Waste Management Authority (Eromosele, 2023).

The projected population growth in Nigeria adds to the mounting challenge, with expectations of surpassing 400 million people by the end of 2050, up from the current population of over 220 million (Uwaegbulam, 2023). Such rapid growth exacerbates the plastic waste management problem, placing greater strain on already limited infrastructure and resources.

Nigeria generates 27.6 million kt16 of municipal solid waste anually, with approximately 13 percent being plastic. The daily per capita waste generation rate in Nigeria is around 0.79 kg/person/day, which is slightly above the West Africa average of 0.66 kg/person/day.

### 2.2.2 Economic and Environmental implications of Plastic Waste.

The waging environmental and economic concerns posed by increased generation, mismanagement and indiscriminate disposal of plastic waste are as a result of several illicit acts including illicit refuse dumping, indiscriminate inceneration or combustion, unsanctioned land fillings, etc have all contributed to environmental implications of plastic wastes and the efforts taken to curb the spread is also taking effects on the economy, agricultural sector is also greatly affected.

Environmental concern is developing as a result of the increased production and improper management of plastic waste worldwide. Primarily, improper management of plastic waste include several management practices, such as uncontrolled landfilling, waste dumping, combustion, littering, and final leakage into the ecosystem.

#### 2.2.3.1 Economic implications

Outbreak of diseases are one of the common causes of economic regression. This has been seen in the outbreak of COVID-19 in Nigeria in the year 2020. There will definitely be an increase in diseases in the environment as a result of the destruction of the environment with single-use plastic waste, which will have a significant negative influence on the nation's economy. Negative effects on the environment and human health result from poor waste management and disposal techniques. Diseases such as malaria, ebola, cholera, diarrhea, and laser fever are more vastly and rapidly spread as a result of poor sanitation standards as this helps the breeding of the pathogens and vectors of these diseases. Poor sanitary conditions have significant economic repercussions for the nation. According to World Bank studies of sub-Saharan African nations, Annually, Nigeria consistently lose more than 4% and 6% of its GDP as a result of poor sanitation, respectively (Olufemi, *et al.,* 2016).

The single use plastic has led to an increase in the importation rate of the country, whereas, a circular plastic economy would have brought about a decrease in importation and possibly export of excess, thereby leading to an increase in the gross domestic product of the country and improvement of the economy (Anabaraonye, *et al.,* 2019). Also, he added that foreign investors and tourists may not be interested in investing or having visitations to the country due to the excess litter and dirtiness accumulates as a result of indiscriminate waste disposal and this will inevitably affect the economy of the country.

#### 2.2.3.2 Environmental implications

The disposal of great amount of plastic waste into oceans is an unavoidable occurrence (Auta *et al*., 2017), with approximately 150 million metric tons of waste accumulation in marine environments (Ellen MacArthur Foundation, 2017). Also, approximately 78% (i.e., 4.9 Gt [4.9 billion metric tons]) of the plastic waste ever produced has either been disposed of in landfills or elsewhere in the environment.  This phenomenon has emerged as a significant peril to the ocean ecosystem and food chains (Wilcox et al., 2015).

Environmental diseases and sanitary-related illnesses such as cholera, food poisoning and even parasitic diseases like malaria is on the increase due to the indiscriminate disposal of wastes because these serves as a breeding site for the larva of these harmful pathogens. This situation poses serious risks to both Nigeria's environmental integrity and its population. Exponential population growth, unplanned urbanization, changes in consumption patterns, unsuitable waste management infrastructure, a lack of government policy implementation on waste management standards, inadequate resources, a lack of trustworthy data, etc. are all factors that make the issue of a proper waste control system worse, leading to a depletion in the ecosystem or economy that is beneficial to the environment.

### 2.2.3 Challenges of plastic waste management in Nigeria

There are various complex challenges involved with the management of plastic waste in Nigeria. These challenges are also directly/indirectly linked with many environmental and health problems, therefore, calls for a coordinated effort to address these issues which include:

One of the key factors contributing to Nigeria's plastic waste dilemma is the lack of adequate waste management infrastructure. Dumbili and Henderson (2020) recorded that one of the ways through which Nigerians manage their waste is by dumping them under bridges and along major highways. This can be attributed to the fact that there are no legally provided waste infrastructure such as incinerators or waste bins located at strategic locations. The lack of efficient waste collection and disposal systems leads to the accumulation of plastic waste in public spaces, rivers, and oceans; leading to environmental pollution and health hazards especially to communities in the locality. In many areas of Nigeria, informal waste collection systems are prevalent due to the absence of formal waste management services. While these systems play a role in waste removal, they often lack proper disposal mechanisms, leading to dumping in unauthorized sites.

In addition, indiscriminate waste disposal is also common in Nigeria due to the lack of implementation of waste policies and lack of stringent laws to punish erring individuals caught doing this illegitimate act. Since people feel they are less likely to get caught, they continue to dispose wastes indiscriminately in drainage channels, on the road and on landfills. Therefore, proper laws must be put in place against bad waste disposal practices as well as officials and agencies be put in charge of apprehending defaulters and appropriate punishment like community service may be meted out by a local court. This will instill the spirit of patriotism and urge to keep the country clean among the citizens of Nigeria.

The prevalence of single-use plastics such as water sachets, plastic shopping bags, plastic beverage containers, etc. is another factor contributing to the plastic waste situation. These items are frequently discarded after a single use, leading to a rapid accumulation of plastic waste.

Additionally, the lack of proper recycling facilities exacerbates the plastic waste problem. Inadequate recycling facilities mean that a substantial amount of plastic waste is not properly processed, leading to more waste being discarded inappropriately. For plastic waste to be kept out of landfills and the ocean, infrastructure investment in recycling is essential. While there might be waste management policies in place, the lack of effective enforcement mechanisms can undermine their impact. Strengthening regulatory frameworks and ensuring their implementation can help deter improper waste disposal practices.

Lack of implementation of sustainability strategies by manufacturing companies is another major concern to the plastic waste situation in Nigeria. These companies are not usually strictly held accountable for their high impact manufacturing and their contribution of heavy plastic wastes due to the nature of their manufacturing packages, being plastics. Unless Nigeria imbibes the low impact manufacturing and clean growth strategy of the UK into her own manufacturing practices and ensure all companies follow it, her economy would grow exponentially and there will be effective waste management. An example of what can be done is the use of biodegradable bioplastics, rather than the complex polymer plastics. These eco-friendly plastics pose no harm to the environment, and are easily degradable because they are of biological origin e.g. cellulose.

However, many studies have noted that the issues concerning plastic waste and its management is exacerbated due to the lack of awareness among the populace (Henderson and Dumbili, 2020). The attitude of Nigerians to plastic waste disposal and management is that of total lacklustre (I do not care attitude) because they generally feel that it does not affect them directly.

## 2.3 Circular Plastic Economy and its significance

The notion of a circular economy transforms how we think about a product's lifecycle, which includes the pre- and post-customer phases. This change in perspective not only reduces plastic pollution but also has significant positive effects on the economy (De Kock, 2022), society, and the environment (Bucknall, 2020). To establish the circular economy in the plastics sector, three crucial actions must be implemented. One of these is the complete elimination of ‘problematic and unnecessary’ plastic products. The elimination of these products, such as stirrers, straws, cutlery, etc., would not result in any changes in consumer behaviour because they are neither reusable, recyclable, nor compostable (US Plastics Pact, 2023). Secondly, new technologies are to be developed to make sure that the required plastics are recyclable, compostable, or reused, lessening their impact on the environment. Thirdly, the useful life of plastic products needs to be extended through recycling to keep them in the loop and avoid releasing them into the environment (Ellen MacArthur Foundation, 2023).

The circular plastic economy (CPE) is a framework that applies the ideas of the circular economy to the entire value chain of plastics, from design to usage to disposal. As a result, the CPE method fosters creative design, supports recycling, and provides incentives for material repurposing, hence minimizing problems associated with the usage and disposal of plastic items (Völker, Kovacic, and Strand, 2020). In other words, the CPE promotes a shift toward more innovative, sustainable solutions to the plastic crisis (Dedehayir, Mäkinen, and Ortt, 2018).

A viable alternative to the challenges associated with the linear economy is the emergence of the concept of a circular economy (Calleja, 2019; European Commission, 2018). The circular economy is based on the principle of keeping materials in a continuous loop, where there is restorative or regenerative use of resources and minimized waste (Geisendorf and Pietrulla, 2017). It is a concept commonly known as a closed-loop economy, pertaining to a system that avoids the generation of excessive waste and instead, converts any waste produced into valuable resources (Wysokinska, 2016). As outlined in the EU Action Plan for Circular Economy, the concept of a circular economy involves preserving the value of products and materials for an extended duration, minimizing waste and resource consumption, and facilitating the continuous reutilization of resources within the economy even after a product's life cycle has concluded. (European Commission, 2015). The core tenets of a circular economy are confined within the 3 Rs paradigm: reduce, reuse, and recycle. The initial "reduce" aspect focuses on the pursuit of enhanced eco-efficiency throughout production and consumption. The second facet, "reuse," signifies an enhanced product design and business model that facilitate a cyclical disassembly and subsequent reuse sequence (Ghisellini et al., 2016). The final element, "recycle," encompasses any waste material recovery process whereby materials are reprocessed into products, substances, or materials, either for their original purpose or alternative applications (Geisendorf and Pietrulla, 2017). However, beyond the simple concept of recycling, circular economy is a system level approach that integrates economic activity with repairing previous environmental damage and social sustainability, such as the generation of new labour force needed for the reprocessing or remanufacturing of goods and materials that will multiply during the circular economic model (Stahel, 2016).

In the context of plastics, the circular plastic economy is aimed at transforming the manufacturing, use, and disposal of plastics. It creates a design where there is reduction in plastic waste and pollution through product material; the retention of resources and products in use; and the regeneration and preservation of natural systems (Plastics Europe, 2018: The Ellen MacArthur Foundation, 2016).

## 2.4 Capacity Building Initiatives

This involves strategies employed in the development of a new technological advancement in promoting a greener economy. It is a group of technical and educational knowledge, government and organisational efforts applied with the objective of helping the stakeholders involved in performing their role in promoting the proper waste management strategies to ensure sustainability. Therefore, it includes the organised activities and processes carried out in order to achieve a change while stating clearly the roles of every stakeholders involved, including government, manufacturing companies and the general public.

## 2.5 Capacity Building Initiatives for Developing Circular Plastic Economy in Nigeria

As a new strategy for reorienting product and service development, creating urban infrastructure, and economic development around maximum resource efficiency and effectiveness, the term "circular economy" is receiving attention in the private sector across Western Europe and the United States. In the production, usage, and disposal phases of goods and materials, and technicalities are being addressed to achieve this. The benefits of the circular economy, which as a development paradigm, may have a distinct meaning for these developing countries, have not yet been thoroughly examined for sub-Saharan African economies.  
The major issues that developing nations like Nigeria, which are just urbanizing, face are social in nature. These include: poverty, as a result of unequal distribution of wealth, youth unemployment, inadequate public health and education systems, lack of waste disposal facilities leading to poor sanitation, improper town planning leading to substandard housing, and unequal access to electricity (Olufemi, *et al.,* 2016)

The transition into a circular plastic economy requires a joint efforts from all the stakeholders, including the government with their guiding policies, the manufacturers, companies and their internal and external stakeholders, the waste disposal organisations like Kaltani, non-governmental organisations (NGOs) and the general populace, all in a bid to promote a sustainable plastic waste management and control through the implementation of the circular plastic economy, hence, leading to a greener environment.

## 2.6 Impacts of Capacity Building Initiatives on the Development of a Circular Plastic Economy in Nigeria

This constitutes the effects of waste management on the economy of Nigeria. There are several pros and cons but it is debatably established that the positive impacts outweigh the negative. There is reduction in the risk associated with the incineration option by the activities of waste recycling and the conversion of waste that has been disposed into new products. Burning plastic causes the emission of harmful gases into the atmosphere, such as greenhouse gases, which intensifies environmental pollution. However, recycling reduces any dangers to existential reality and absolves the locality from responsibility for environmental sustainability. The likelihood of a disease breakout is decreased by waste recycling. As a result, it is used as the foundation for disease control. Recycling waste protects locals from pollution of the air, water, and land. It lessens the practice of open-air burning and landfill fires In Nigeria, and throughout the world, one of the significant drivers of entrepreneurship revolution is recycling. There is a large number of underemployed and unemployed youths in Nigeria's main cities and rural areas, many young people’s interest is inclined to the refuse and waste recycling industry as a way to increase their income and lower the dangers associated with their numerous survival endeavors. When fully utilized, waste recycling can serve as a foundation for creating jobs, money, and the heart of socioeconomic development (Anabaraonye, *et al.,* 2019).

Practice of waste disposal also has positive significance on the conservation of energy required in the manufacture of virgin plastics. The energy conserved is in the form of electricity and fuels. The recycling of wastes also help to reduce the cost and consequences of waste disposal. When a circular plastic economy is embraced, which involves the recycling of plastics, it also reduces the cost of waste disposal. Recycling also prevents the emission greenhouse gases (GHGs) as a result of combustion during the incineration process. This process of recycling helps to prevent global warming

## 2.7 Stakeholders Analysis

This section aims to understand key participants involved in the development of the circular plastic economy in Nigeria, highlight their important obligations and state the path to fulfilling them. The major stakeholders includes the government of Nigeria who make the policies on waste management and also puts measures in place for the implementation of these policies, the waste management organisations who are responsible for directing the affairs of managing and recycling waste in the country e.g. Lagos State Waste Management Authority (LAWMA) which is government owned and Kaltani which is a private Non-Governmental Organisation (NGO).

Other stakeholders involved may include the civil society, digital innovation firms with strong interest in plastic waste management, academias and the community at large which involves the citizens of the federal republic of Nigeria. All these stakeholders all have a part to play in actualising the initiative (Kolade, *et al.,* 2022).

1. Government

They are responsible for making and implementing policies that guides the waste management of the country. These policies are usually implemented at local levels to ensure proper overseeing of the project. The government agency responsible for creation of such policies in Nigeria is Federal Ministry of Environment in Nigeria (World Bank, 2018). They make recycling laws, as well as implement policies that guides waste management and promotes sustainable plastic use in the country. They also ensure the compliance of manufacturing industries with the principles of the circular plastic economy. Some of these government policies that promotes circular plastic economy may include incentives, taxes and bans on defaulters. Stringent punishment such as heavy fines should also be put in place for anyone found wanting of the policy requirements (NESAT, 2020).

1. Manufacturing Industries and Companies

Development of disruptive innovations on the circular plastic economy, such as use of bioplastics instead of plastics is one of the key roles of manufacturing companies in order to align themselves with the policies of Nigeria government clean growth strategy in order to maintain sustainability standards to promote the economy. With the understanding that single use plastics is the factor responsible for the depleting of the economy, industries must put structures and recycling facilities in place in order to achieve the sustainability standards. The purpose of these manufacture of their plastic packaging materials should be designed in such a way that it will be easily recycled based on the composition and morphology of the waste (UNEP, 2018).

1. Academias and Research Institutions

The knowledge and discipline of the circular plastic economy should be inculcated and taught in higher institutions. These institutions are responsible making research for effective alternatives such as digitalization of the circular plastic economy plan (NUC, 2021).

1. Financial Institutions and Investors

Companies like Kaltani can pump her resources into the promotion of the circular plastic economy and may even obtain grants from the World Bank in order to promote the recycling of wastes. These grants are used to employ hands to clean the waste, and the facilities needed to convert these wastes into useful non-plastics once again or any other useful products (World Bank, 2018).

1. Investors

These set of people may be single individuals or partner companies who are willing to stake her resources maybe in form of shares, to support the capacity-building initiative of CPE in Nigeria. They usually do this with the aim of achieving long term profits in their shares increase as the organization progresses later in life. Kaltani as a circular plastic economy promoter can implore its investors pump money into her capacity building initiative programs in order to facilitate rapid progress.

1. Waste Management Companies

They may be private owned or government owned and they are responsible for the collection, sorting, management and recycling of plastic wastes.

1. Consumers and Local Communities

They are the key individuals responsible for the return of plastic wastes to the manufacturers. They must also obey the policies of proper waste disposal strategies put in place. Their cooperation is needed by the industries to achieve the recycling program

# CHAPTER THREE

# METHODOLOGY

## 3.1 INTRODUCTION

The general research plan of this study is embedded in this chapter which lays emphasis on the processes involved in the conduction of this study. It contains the philosophy of assumptions and status quo put forward concerning Nigeria's state of plastic economy and hopes to prove the most effective capacity building program with the most maximum yield to difficulty ratio.

### 3.1.1 Research Design

The main aim of this study is to develop a circular plastic economy in Nigeria using capacity-building initiatives, which is the most populated country in Africa (Kamer, 2023).

Due to the complexity of this study and its aims and objectives, the most suitable research design is the exploratory research study. The exploratory research design would permit the researcher to investigate the phenomenon in-depth, better define the problems and discard ineffective ideas (Swaraj, 2019). The case study approach has been praised as a solution to research questions such as how, what and why (Lucas, *et al.,* 2018). The researcher will be able to gather a large amount of detailed scientific work done with the case study approach, on the subject matter (Krusenvik, 2016). This study also used a secondary data collection method through the use of existent data on the topic, this will enable the researcher to conduct a comparative study on the most efficient initiative, assess its advantages, and recommend the most suitable initiative for the Nigerian economy.

## 3.2 Case study selection and rationale

Sampling, in the words of Johannesson and Perjons (2014), is the process of choosing individuals from a population. Probability and non-probability sampling are two general categories for sampling procedures (Turner, 2019). The latter is the opposite of the former in that while there is no known chance of the sample elements being selected in the latter, there is a clear known probability that the individuals in the sample will be chosen in the former (Bhardwaj, 2019). Because utilising probability sampling techniques would be more expensive, the researcher uses non-probability sampling procedures in this study. Therefore, three capacity-building initiatives were selected using purposive sampling techniques. Purposive sampling is a non-probability sampling technique which simply refers to the technique of selecting respondents related to the topic of study (Etikan, *et al.,* 2016). This allows the researcher to customise the designs which are more favourable in answering the research questions (Baiju, 2022).

These capacity-building initiatives are as follows: plastic collection and recycling, conversion of plastic waste to energy and consumer education and training. Plastic collection and recycling was included based on the recent measures made by various companies to collect and recycle waste also because the demand for recycled plastics is increasing globally (Ntoka, 2023) and Nigeria can tap into that market. The initiative of the conversion of plastic waste to energy was selected because Nigeria currently battles with provision of energy (both electricity and fuel) for its citizens, so this capacity-building initiative is important as it also gives back to the nation’s economy. Lastly, consumer education and training is important to enlighten the populace on the dangers of indiscriminate dumping and disposal of their single-use plastics. These initiatives were also selected because they had some information from which the researcher may gain insights from. In terms of economic viability, adaptability, geographic coverage, and durability within the scope of the research region (Nigeria), the chosen initiatives are information-rich. In a nutshell, there is much that can be learnt about this important topic, making it worthwhile to conduct in-depth research.

## 3.3 Collection of data

The standard and verified data on the management of plastic waste in the majority of sub-Saharan African nations (including Nigeria) are not available (Ayeleru, *et al.,* 2020). The current study used a qualitative research approach to gather its data. Justification for choosing the current methodology includes:

1. Qualitative research generates rich, thorough, and reliable process data based on the perspectives and interpretations of the participants rather than those of the researcher (Verhoef and Casebeer, 1997).
2. As stated by Ezeudu and Ezeudu (2019), quantitative methods are less able to capture the details and provide insights when the aim of the study is to understand the richness and complexity of the phenomenon.
3. Additionally, with the use of case studies and qualitative methods, additional insights and concepts can be disclosed for further investigation or studies. This is because the case study approach aids in the development of a full understanding of how things work realistically (Crowe, *et al.,* 2011), rather than evaluating hypotheses that are taken from current theory.

The information needed for this study was gathered using official records from academic journals that have been peer reviewed, business websites, financial reports, policy briefs, publications from the government, periodicals and newspapers.

## 3.4 Case study description

This subsection provides a comprehensive explanation of the three initiatives introduced in the previous subsection (3.2). For each capacity-building initiative, the results of the information analysis are summarised and descriptions of present practices, problems, opportunities, and issues are described. Table 1 displays a summary.

### 3.4.1 Plastic Collection and Recycling

The generation of waste is an integral part of human activity, shaped by social dynamics and economic progress (Wang, 2020). The alarming increase in waste generation and environmental pollution constitutes one of Nigeria's most pressing environmental challenges (Kehine, et al., 2020). This predicament can be primarily ascribed to the rapid urbanisation, escalating per capita income, heightened consumption patterns, and the overall population growth that the country has witnessed over the past two decades are mostly to blame for this predicament (Kehinde, et al., 2018), combined with a lack of sufficient waste management and infrastructure and strategies. Plastic production and plastic product manufacturing in Nigeria has experienced a notable increase, with a 13 million-tonne increase recorded between 2015 and 2016, a figure surpassing global records (Plastic Europe, 2017). The primary source of plastic waste predominantly falls within the category of disposable products, primarily encompassing single-use plastic items (polybags, food utensils) and packaging materials (Duru, et al., 2019). The packaging sector stands as the largest consumer of plastics, driven by the integral role of packaged goods in our daily lives. People often prefer to employ plastic for wrapping products, particularly food items, rather than handling them directly due to concerns regarding potential pathogens in bare hands (Onyekachi and Chukwuemeka, 2022; Shah et al., 2008). Consequently, the accumulation of plastic waste, a substantial portion of which comprises single-use items, emerges as a pressing concern due to its multifaceted impact on both the environment and human health. The high amount of waste plastics consequently affects the ecosystem through soil pollution by land filling, marine pollution by ocean dumping and air pollution by open dumping (Mourshed, et al., 2019; Paletta, et al., 2019)

Non-biodegradable plastics can persist in the environment for hundreds of years but can be reduced to macro- or microplastics (Ukaogo, et al., 2020). These microplastics are easy to penetrate and find their way into the environment by primary and secondary sources, thereby, toxifying the land due to the chemical degradation of its organic decomposition (Evode, et al., 2021). Many health problems have been connected to the toxic substances released by microplastics that are made from harmful chemicals, some of which possess carcinogenic properties, act as endocrine disruptors, or trigger other toxic responses. Moreover, harmful substances such as persistent organic pollutants (POPs), which are commonly employed as pesticides, solvents, and industrial agents (e.g., DDT and PCB), can be leached to the environment (Cook and Halden, 2020). Consequently, these contaminants can enter the food chain through both terrestrial and marine ecosystems, ultimately accumulating in the tissues of living organisms.

A 2018 estimate shows that single-use plastics account for 60-90% of global marine plastic pollution (Schnurr, et al., 2018). Nigeria’s extensive land based sources near coastline and rivers further inland contribute the large majority of marine plastic pollution. Plastics irresponsibly discarded on land eventually find their way into rivers, streams and the ocean. Due to the challenges of collecting ocean plastic and the persistent nature of plastic in the environment, (MacLeod, et al, 2021) once plastic is in the ocean it’s almost impossible to remove it. Moreover, once it has entered the ocean, it continues to break down: macroplastics become microplastics, and microplastics become nanoplastics, making recovery even more unlikely.

Even if all plastic pollution inputs into the ocean were to stop today, this process of degradation means the mass of microplastics in oceans and beaches will more than double between 2020 and 2050 (Lebreton, et al., 2018). This contamination has dire consequences for marine life. Aquatic animals often mistake plastic debris for food, leading to ingestion and fatalities. Also, the accumulation of plastic wastes in oceans disrupts marine ecosystems and impacts fishery resources.

Plastic collection and recycling serves as a vital component in battling plastic waste pollution. They play a vital role in mitigating the environmental impact of plastic waste and contribute significantly to sustainability efforts. Recycling refers to the waste management method which collects waste materials and converts them into raw materials that can be reused to form other valuable products (Evode, et al., 2021). Plastics are non-biodegradable as carbon-based products and other polymers. It contains bottles and other materials that can be melted and transformed into other products like plastic tables and chairs. This process is performed in the following six steps: collecting waste plastics, sorting, or arranging plastics into categories, washing to remove impurities, shredding and resizing, identifying and separating plastics, and compounding (Szostak, et al., 2020). There are several benefits of plastic waste recycling that the world can gain when plastic are reused rather than disposing of them in non-desirable places, by collecting and recycling plastics, we divert a substantial amount of waste away from landfills and incineration, reducing the burden on these disposal methods and also protecting human life by decreasing carbon dioxide and other harmful gases that occurs during the process. (Vollmer, et al., 2020). Additionally, recycling plastics results in reduced greenhouse gas emissions. The production of new plastic materials is energy-intensive and releases significant amounts of carbon dioxide into the atmosphere (Li Shen, and Ernst, 2014). Recycling consumes less energy, thus contributing to lower carbon emissions and a more sustainable future.

#### 3.4.1.2 Initiatives and programs

Several organisations, NGOs, and government agencies in Nigeria have initiated comprehensive plastic collection and recycling programs aimed at promoting sustainable practices and reducing plastic pollution. These initiatives employ a variety of methods to achieve their objectives:

**Kaltani Plastics Recycling Company**

KALTANI is a clean technology plastic recycling and waste management company that is continuously tackling the global plastic epidemic by utilising systematic, scalable steps to reduce post-customer PET, PE, and PP plastics. Unlike a lot of companies in the recycling space, Kaltani covers the A-Z chain of plastic recycling; the core tenets are confined within the 4 “Rs” paradigm: Recover, Reduce, Reuse, and Recycle.

Collection Methods: KALTANI’S primary activities involve the recovery/collection of improperly disposed bottles or other plastic garbage from immediate surroundings, waterways, coastlines, and oceans by a team of 100 employees split between the start up’s collection sites, recycling factory, and offices. The debris is then transferred to one of its collection centers, where it is sorted into three different kinds of plastics PET (polyethylene terephthalate), example is a soda bottle; PE (polyethylene), example is a pure water sachet; and PP (polypropylene), which can be plastic products such as chairs, buckets, and tables, are compressed and baled before being delivered to a recycling facility. Plastic pollution is also reduced by mitigating the inflow of plastic by gradually changing consumer habits.

Recycling Processes: The plastics are subsequently processed at two large factories - one for PE and PP recycling, and the other for PET recycling. Different machines for removing labels, removing metal pieces, hot washing, friction washing, grinding, separating, and drying are used in converting plastic waste into hot-washed PET flakes, PE pellets, and PP pellets for reuse in FMCG companies as thermoform, sheet, packaging, bottling, and fibre flakes (used in the manufacturing of clothes) to reduce dependency on virgin materials. It focuses on helping companies reduce their carbon emissions and do their part to achieve carbon neutrality. To provide transparency and traceability throughout the value chain, Kaltani’s technology employs data analytics, predictive analytics, and geo-mapping.

Scale of Operations:

During its inaugural operational year, the company's reach expanded globally, supported by a secured seed fund totaling $4 million, designated to boost its operations. This fund is aimed at the establishment of 20 novel collection and aggregation centers throughout Nigeria, accompanied by the augmentation of its workforce to encompass over 500 individuals. This notable enhancement in workforce capacity will substantially empower Kaltani to process up to 15,000 metric tons of plastic waste annually. Additionally, the fund allocation aims to bolster logistical infrastructure within Nigeria.

Kaltani Recycling Company serves as a beacon of hope in the fight against plastic pollution, showcasing how a combination of community engagement, advanced technology, and innovative thinking can make a substantial difference in environmental sustainability.

Case study 2: Wecyclers

Wecyclers is a socially-driven, for-profit enterprise committed to advancing environmental sustainability, fostering socioeconomic development, and enhancing community well-being. The mission revolves around offering accessible recycling services in densely populated urban areas. They empower households to derive value from their waste while ensuring a dependable source of raw materials for the local recycling sector.

Collection Method:

Wecyclers' core operations revolve around the retrieval and proper management of discarded plastic waste. Central to our system is a rewards-for-recycling platform, strategically designed to motivate individuals within low-income communities to unlock the value in recyclable materials. This platform is underpinned by a fleet of cost-effective, locally assembled cargo bicycles referred to as "wecycles." Our collectors employ these wecycles to gather recyclable waste from households, subsequently transporting it to our collection, sorting, and packaging hubs.

As a token of appreciation for their recycling efforts, service subscribers receive rewards in the form of points for each kilogram of recyclable waste they contribute. These accumulated points can be exchanged for essential commodities such as food and household items. The collected materials are then dispatched to manufacturers who transform the recyclable materials into an array of new products, including tissue paper, bedding materials, durable plastic furniture, aluminum sheets, and nylon bags.

Scale of Operations:

Since its inception in 2012, this startup has achieved remarkable milestones. It has successfully gathered over 600 tonnes of recyclable materials, with participation from more than 6,500 households. In the process, it has generated 75 jobs, encompassing roles such as 25 dedicated cyclists, aptly referred to as "Wecyclers," as well as workers within processing plants and other positions. This achievement is particularly significant in a city grappling with an unemployment rate exceeding 20 percent.

Collaborating closely with the Lagos Waste Management Authority, Wecyclers has ambitious plans to enroll one million homes in Nigeria's most populous city and expand its reach to other parts of the country. With this expansion, Adebiyi, the founder, envisions the potential creation of 500,000 direct and indirect jobs, encompassing roles for cyclists, processing plant employees, and individuals involved in bicycle production.

Wecyclers' innovative model has garnered recognition and accolades, including the prestigious 2014 Sustainia Award and the 2013 Intel Environment Award.

### 3.4.2 Consumer education and training

One of the vital factors that must be considered towards achieving a circular economy is the psychological attitude of consumers (Singhal et al., 2019). Consumer education is a pivotal element in the journey towards establishing a circular plastic economy (de Sousa, 2023) especially in Nigeria. This holistic approach recognises that consumers, armed with knowledge and awareness, have a profound impact on reducing plastic pollution and promoting recycling within the nation (Tiippana-Usvasalo, *et al.,* 2023). At its core, this education serves as a catalyst for change (Keramitsoglou, *et al.,* 2023), as informed consumer behaviour plays a pivotal role in mitigating plastic pollution and advancing recycling efforts (García-González, *et al.,* 2022). When consumers are equipped with knowledge about responsible plastic use, recycling practices, and the environmental impact of their choices, they become active participants in the circular plastic economy. Their decisions to reduce, reuse, and recycle plastic materials contribute significantly to minimising waste, conserving resources, and fostering sustainable practices in Nigeria's plastic industry.

This behavior of individual consumers constitutes the attitude of the entire community and has a great influence on the circular behavior of that community. This collective attitude of the community may have a direct impact on the authorities that enforce circular regulations or spearhead a movement towards circular behavior (Muranko, et al., 2019). The best way of molding the behavior of the community of consumers is through education and awareness. The impact of education on the behavior and attitude of the consumers is that it provides them knowledge that helps them to understand their roles in the preservation of the environment. It also modifies their attitude towards other social causes (Okur and Saricam, 2019). This knowledge also influences the consumer brand product value perception and their purchase behavior. With education, consumers develop concerns for the welfare of the circular plastic economy as it instills in them a sense of responsibility and active participation in the protection of the environment (Patwa, et al., 2021).

The consumer has an important role in supporting the circular plastic economy in the aspects of their purchase behavior and the choice of products they buy. They must support products that come in eco-friendly packages that promote sustainability and not substandard ones.

They may also support the circular plastic economy by patronizing durable and recyclable products rather than the single-use products. This will ensure the fulfillment of the circular economy.

Lastly, proper disposal of products after use is a very paramount role of consumers in preserving the circular plastic economy. All these can be achieved through proper enlightenment and persuasion of the consumers on the purchase of quality eco-friendly products as well as provide them with the knowledge of the proper channels of disposal of recyclable products.

#### 3.4.2.1 Objectives of Consumer Education and training

This emphasizes the reason for the need for consumer education. It talks about the outcomes that the education of consumers on the circular plastic economy proposes to achieve, and the steps taken to fulfill these objectives. Some of the objectives and goals of consumer education in the context of developing a circular plastic economy include:

i. To create awareness to consumers on the negative impacts of plastic pollution on the ecosystem, highlighting its contributions to the pollution of aquatic environment, the wildlife and the increase in emission of greenhouse gases (GHG).

ii To promote responsible consumption by ensuring that consumers make informed decisions in their purchase behavior and also go for goods with sustainable packages.

iii. To instill the culture of recycling in the consumers so that they feel responsible for the proper disposal of used products.

iv. To support policies and regulations guiding the development of the circular plastic economy put in place by the regulating bodies.

v. To eradicate single-use plastic wastes of the linear economy.

The significance of consumer education in this context cannot be overstated, and it extends to multiple facets such as:

**Shaping consumer behaviour and reducing plastic pollution**: Consumer education empowers individuals to make informed choices regarding their use of plastic products. It raises awareness about the environmental consequences of plastic pollution and the benefits of adopting sustainable practices. Educated consumers understand the lifecycle of plastics and the harm caused by improper disposal, therefore are more likely to reduce single-use plastic consumption, adopt habits like reusable shopping bags, bottles, and containers, which significantly decrease plastic waste and opt for alternatives (Ledsham, 2023).

**Promoting Responsible Consumption**: Consumer education emphasises responsible consumption patterns. Responsible consumption refers to the practice of making decisions which have the least possible negative effects on the environment and promotes social justice (Liarakou, 2019). Therefore, when consumers are encouraged to consume plastics responsibly, they choose products with minimal or recyclable packaging and to opt for eco-friendly alternatives. Also, informed consumers are more likely to support businesses that prioritise sustainable packaging and practices, influencing market demand.

**Encouraging Recycling Participation**: Consumer education can break down the barriers to recycling participation. Studies have shown that most consumers do not have the knowledge of what and what not to recycle (Strydom, 2018; Jacobsen, *et al.,* 2022). Therefore, when consumers understand the value of recycling and its positive environmental impact, they are more motivated to actively engage in recycling programs. Educated consumers are less likely to contaminate recycling bins with non-recyclable materials, which enhances the efficiency of recycling processes.

**Fostering a Circular Mindset**: Consumer education contributes to the development of a circular mindset. It is said that circular mindsets are the modifications that must be made to design thinking in order to incorporate both components of circularity into products and to use these offerings to profit from the circular economy (Gomes, *et al.,* 2022).This means viewing waste not as an end but as a resource to be reused or recycled. Consumers who understand the circular economy concept are more likely to support initiatives that aim to close the loop on plastic products, such as extended producer responsibility (EPR) programs.

**Driving Market Demand for Sustainable Products**: In a circular plastic economy, the demand for sustainable and recyclable products increases (Friant, *et al.,* 2022). Consumer education plays a critical role in creating this demand. When consumers prioritise products with eco-friendly packaging or materials, businesses respond by innovating and producing more sustainable options. Ultimately, consumer education fosters a sense of environmental stewardship. It instils a commitment to protecting Nigeria's natural resources and reducing the environmental impact of plastic waste. Informed and engaged consumers become advocates for change, encouraging their peers and communities to adopt sustainable practices.

#### 3.4.2.2 Initiatives and Programs

These refers to the initiatives put in place in order to reach out to the consumers with much ease. Several organisations, NGOs, and government agencies in Nigeria have initiated comprehensive consumer education programs aimed at promoting sustainable practices and reducing plastic pollution. These initiatives employ a variety of methods to educate and engage consumers:

1. Chanja Datti in partnership with W.A.S.T.E Africa: This non-governmental, non-profit and non-religious organisation is concerned with offering free education on waste management to women and youths.
2. Greenland initiative- PlasticSmart waste management: One of the many aims of this initiative is to conduct workshops and seminars in schools and communities across Nigeria, focusing on educating students and residents about responsible plastic use, recycling, and the environmental impact of plastic pollution (Makanga, 2023).
3. EcoWarriors Nigeria: is an organisation primarily led by young activists who engage schools and universities in workshops and seminars. These trainings are focused on educating youth about the importance of reducing plastic waste (EcoWarriors, 2023). The organisation utilises creative approaches, such as art exhibitions and eco-friendly product expos, to drive home their message.

These consumer education initiatives in Nigeria employ a multifaceted approach, combining in-person workshops, seminars, awareness campaigns, and the power of online platforms to reach diverse demographics. By involving government agencies, NGOs, and grassroots organisations, these efforts collectively contribute to raising awareness, changing consumer behaviour, and fostering a more environmentally conscious society committed to reducing plastic pollution.

### 3.4.3 Conversion of plastic waste to energy

Within the framework of the circular economy, one pivotal initiative stands out: the conversion of plastic waste to energy. Nigeria is a nation struggling with the provision of clean and affordable energy to its citizens but it can turn that tale around with the conversion of its enormous plastic waste into clean energy in form of biohydrogen, renewable fuels or bio-oil (Awogbemi and Von Kallon, 2023). This is also in line with SDG 7 which calls for access to reliable, cost-effective, modern and sustainable energy (United Nations, 2023). Plastics can be converted into sustainable energy because they contain carbon and hydrogen making its energy composition similar to that of refined fuels such as diesel and the process of converting plastic (in all its varied forms such as plastic bottles, water sachets, grocery bags, etc) into sustainable energy is termed **cold plasma pyrolysis** (Averda, 2023). Pyrolysis is a technology which is cost-effective and environmentally friendly that involves the recovery of energy from waste plastic (Padmanabhan, *et al.,* 2022). This process not only addresses the mounting plastic pollution problem but also plays a significant role in promoting recycling and sustainability. There are also other processes which can be used to convert plastic waste to energy and they include: incineration, gasification and anaerobic digestion (Nextier, 2023). This section delves into the importance of converting plastic waste to energy within the broader scope of developing a circular plastic economy in Nigeria and highlights its crucial role in mitigating plastic pollution while fostering recycling practices.

#### 3.4.3.1 Objectives of conversion of plastic waste to energy

The conversion of plastic waste to energy within the context of the circular plastic economy in Nigeria serves several specific objectives, each of which contributes to the overall goals of sustainability, resource efficiency, and environmental protection. Here are some of the key objectives:

**Waste Reduction and Diversion:** One of the primary objectives is to reduce the volume of plastic waste that ends up in landfills or pollutes the environment. By converting plastic waste into energy, a significant portion of plastic waste is diverted from conventional waste disposal methods, such as landfilling or incineration, which can release harmful emissions.

**Energy Generation**: Converting plastic waste to energy yields a valuable resource. It contributes to the generation of electricity, heat, or synthetic fuels. This energy can be utilized for various purposes, including powering industries, homes, and communities. In a country like Nigeria, where energy demand is high, utilizing plastic waste as an energy source helps meet energy needs sustainably.

**Reduction in Greenhouse Gas Emissions**: The combustion of plastic waste to produce energy can be carried out in a controlled manner, reducing the release of greenhouse gases compared to uncontrolled burning or decomposition in landfills. This contributes to climate change mitigation and aligns with Nigeria's commitments to reduce its carbon footprint.

**Resource Recovery**: The conversion process can recover valuable resources from plastic waste, such as chemicals or hydrocarbons. These can be used in various industrial processes, reducing the reliance on fossil fuels and virgin plastic production. It aligns with the circular economy principle of maximizing resource use.

**Job Creation:** Establishing facilities for plastic waste-to-energy conversion creates employment opportunities within the recycling and energy sectors. This can help stimulate economic growth and alleviate unemployment issues, especially in regions with high plastic waste accumulation.

**Environmental Remediation**: Plastic waste is a pervasive pollutant in Nigeria's natural landscapes, waterways, and oceans. Converting plastic waste to energy contributes to the cleanup of these environments, reducing the harm to wildlife and ecosystems. This objective aligns with broader environmental conservation goals.

**Promotion of Recycling**: By providing an additional avenue for plastic waste management, the conversion of plastic waste to energy complements recycling efforts. It can encourage the collection and sorting of plastic waste, creating a supply chain for feedstock that can be used in energy generation or recycled into new products.

Achieving these objectives contributes to the broader goal of creating a sustainable and circular plastic economy that minimizes waste and maximizes the value of plastics while preserving the environment and benefiting society.

# CHAPTER FOUR

# FINDINGS AND DISCUSSION

This chapter aims to discuss the findings made on this study according to existing literature and the secondary data gathered as stated in the methodology section. It also seeks to understand the potential and imminent challenges that the development of a circular plastic economy faces in Nigeria including; Lack of policy and law enforcement, lack of funding, insufficient resources, lack of public awareness, lack of cooperation from the members of the public, low interest of stakeholders in the circular plastic economy and lack of integrated/collaborative approach to building the capacity initiatives.

## 4.1 Lessons from the case studies

From the case study on consumer education and training, it revealed that generic or one-size-fits-all messages may not engage diverse Nigerian populations effectively. Therefore, educational messages should be tailored to resonate with the local culture and language. Use relatable examples and stories that consumers can connect with. Secondly, initiatives that neglect community involvement may struggle to gain acceptance and participation. Therefore, the local communities can be actively engaged by involving them in cleanup drives, recycling initiatives, and decision-making processes. Thirdly, environmental education (EE) should be incorporated into the curricula of schools to reach children and young adults, who are often change agents within their families. However, advocacy and policy support may help with resistance from educational institutions. In doing all the above-mentioned, local customs and traditions should be respected and incorporated into educational programs to avoid cultural clashes because cultural insensitivity can lead to resistance or misunderstanding among communities.

The case study on the conversion of plastic waste to energy revealed some useful insights. Projects involved in this capacity-building initiative are mostly successful if their technology can be adapted to accommodate various types of plastic waste, including hard-to-recycle plastics. This adaptability increases the efficiency and economic viability of the process. This is very important as flexibility in technology selection is valuable in addressing the diversity of plastic waste streams. Secondly, it is paramount that these companies diversify their product portfolio to include synthetic fuels, waxes or chemicals which are by-products from plastic waste. Diversification is very helpful as it can increase the economic viability of the initiative.

## 4.2 Challenges and barriers to circular plastic economy adoption

Implementing capacity-building initiatives in the context of developing a circular plastic economy in Nigeria is not without its challenges. Several hurdles need to be overcome to ensure the effectiveness of such initiatives. Here are some key challenges and barriers:

1. Lack of Policy and Regulations Enforcement:

In Nigeria, indiscriminate refuse and waste disposal is the order of the day, characterised by illegal dumping sites, disposal of wastes on the roadside, in the gutter, or even in the nearest water bodies. These atrocities are jointly committed by individuals and even companies.

There are several policies that are put in place to curb such barbaric acts of indiscriminate waste disposal, which mostly involves plastic wastes due to the high rate of consumption of plastic-packaged products in the country. However, these policies and laws lack proper implementation due to several reasons including: lack of stringent punishment to offenders, lack of cooperation from members of the public in proper waste disposal, lack of enough manpower and technology to monitor and apprehend perpetrators of activities involving indiscriminate waste disposal and insufficiency of amenities used in the collection and sorting of refuse and waste, recyclable plastics in this case.

These are huge challenges affecting the successful development of the circular plastic economy in Nigeria. Since the state and local governments are in charge of waste management, it is imperative that they understand how to carry out the obligation.

1. Lack of Funding

In Nigeria, there is very little consideration given to the circular plastic economy. That is, it is not getting the much attention it deserves. This situation is detrimental for because funding is pivotal to advancing the circular plastic economy in Nigeria. The World Bank has participated in multilateral efforts in Nigeria and has carried out initiatives in Lagos to support the composting and landfilling of organic waste and urban solid waste as a crucial component of infrastructure support. In 2021, the World Bank launched a global initiative called "Pro Blue Marine Plastic Litter" with the goal of assisting Nigeria with its political initiatives (UNIDO, 2021). While this initiative is beneficial, there is a need for more sustainable, domestically-driven financing mechanisms to ensure long-term success in circular plastic efforts. Additionally, the process of accessing funds and grants for circular plastic projects can be cumbersome due to bureaucratic hurdles. This can discourage organisations, small and medium-sized enterprises (SMEs) and entrepreneurs from pursuing initiatives that promote sustainability. Financial institutions may perceive these ventures as high-risk, making it challenging for them to secure the capital needed to expand or innovate their operations. Efforts to raise awareness, improve access to financing, streamline regulatory processes, and foster collaboration between public and private sectors are essential steps in overcoming this challenge and promoting sustainable practices in plastic waste management.

1. Infrastructure and Access Issues

In rural areas of Nigeria, the lack of proper waste management infrastructure can make it challenging to implement recycling programs effectively.

Additionally, access to educational materials and programs may be limited in remote or underserved communities, affecting the reach of consumer education initiatives.

1. Resistance to Behavioural Change

Consumer Resistance: Changing consumer behaviour can be difficult, especially when it involves breaking habits related to plastic consumption. Resistance to behavioural change can undermine the impact of education efforts.

Business Interests: Some businesses may resist consumer education efforts that encourage reduced plastic use, as it may impact their sales of plastic products.

1. Lack of Awareness:

Consumer Awareness: Many consumers in Nigeria may lack awareness of the environmental impact of plastic pollution and the benefits of recycling. This lack of awareness can hinder the success of education programs.

Stakeholder Awareness: Even within government agencies and businesses, there may be limited awareness of the importance of consumer education in the context of a circular plastic economy.

There is also limited awareness among the general population about the benefits and processes of converting plastic waste to energy which can hinder public support and participation in such initiatives

1. Technical and Technological Barriers:

Implementing advanced technologies for efficient plastic collection, recycling and plastic-to-energy conversion can be technically complex and may require specialized knowledge and equipment. Additionally, building and maintaining the necessary infrastructure for plastic waste collection, sorting, and conversion requires significant investment and planning.

Addressing these challenges is essential for the effectiveness and sustainability of capacity-building initiatives in Nigeria. A coordinated effort involving government agencies, private sector investment, NGOs, and public awareness campaigns is necessary to overcome these barriers and unlock the full potential of managing plastic waste effectively. Successfully implementing such initiatives can help address plastic pollution, contribute to clean energy generation, and promote a circular economy in Nigeria.

## 4.3 Opportunities for scaling up these initiatives

1. Collaborative Partnerships: Successful initiatives often involve multiple stakeholders working together to achieve common goals. Therefore, partnerships should be forged between non-governmental organisations, government agencies, businesses, and local communities to pool resources and expertise.
2. Practical Workshops and Demonstrations: Conduct practical workshops and hands-on demonstrations to show consumers how to reduce, reuse, and recycle plastic products. Some programs have introduced DIY recycling workshops, teaching communities how to repurpose plastics into useful items.
3. Digital and Social Media Campaigns: Leverage digital platforms and social media to reach a broader and tech-savvy audience. Share engaging content, such as videos and infographics, to convey messages effectively. Gamification apps and interactive social media challenges have been used to raise awareness and encourage sustainable behaviour.
4. Incentives and Rewards: Offer incentives, such as discounts on eco-friendly products or recognition for active participation in recycling programs. Loyalty programs that reward consumers for recycling or reducing plastic consumption have shown promise.
5. Continuous Monitoring and Feedback: Establish mechanisms for ongoing monitoring and feedback collection to evaluate program effectiveness and make necessary adjustments. Some initiatives use mobile apps for users to report recycling activities and provide feedback.
6. Feedstock Collection and Quality Control: Establish a robust system for the collection, sorting, and processing of plastic waste to ensure a consistent and high-quality feedstock. This is because high-quality feedstock is crucial for efficient energy conversion and minimizing operational challenges.
7. Technology Selection: Selecting the right technology is essential for optimizing energy recovery and minimizing environmental impacts. Therefore, the appropriate technology should be carefully chosen for plastic-to-energy conversion, considering factors like the type of plastic waste available and the local energy demand.
8. Community Engagement: Involve local communities in waste collection and segregation efforts, emphasizing the economic and environmental benefits of the initiative. This is very important as community buy-in is critical for a consistent supply of feedstock and the success of plastic-to-energy projects.

# CHAPTER FIVE

# CONCLUSION AND RECOMMENDATIONS

## 5.1 Conclusion

This research study was conducted with the primary objective of assessing the significance of capacity-building initiatives in propelling the development of a circular plastic economy within the Nigerian context. To achieve this objective, an exploratory research design was adopted, coupled with qualitative secondary data collection methods. This approach relied on the comprehensive analysis of previously published articles sourced from peer-reviewed journals, newspapers, and various reputable publications to extract valuable scientific evidence and insights.

Furthermore, this study employed a multiple case study approach to delve into the intricacies of the subject matter. The selection of case studies was carried out through non-probability sampling techniques, specifically convenience sampling, in order to ensure practicality and accessibility for the research.

The findings gleaned from this study revealed a significant aspect of the circular plastic economy in Nigeria, which is still in its nascent stages, mirroring the developmental trajectory observed in other emerging economies. The core focus of this research revolved around three pivotal capacity-building initiatives:

Plastic Collection and Recycling: This initiative encompasses the collection and recycling of plastic waste materials, a fundamental process that serves as a linchpin in the circular plastic economy. The study assessed the capacity of Nigeria in effectively executing this initiative, highlighting its potential to drive sustainable practices.

Conversion of Plastic Waste into Energy: The conversion of plastic waste into energy represents an innovative approach to both waste management and energy generation. The study explored the readiness and suitability of Nigeria for implementing this capacity-building initiative, considering its significant benefits.

Consumer Education and Training: Equipping consumers with knowledge and awareness regarding responsible plastic consumption and recycling practices is a critical aspect of transitioning to a circular plastic economy. The study examined the capacity of Nigeria to educate and train its populace effectively in this regard.

In summary, this research underscores that while the circular plastic economy is still in its infancy within Nigeria, it aligns with the developmental trajectories observed in other emerging economies. The capacity-building initiatives of plastic collection and recycling, conversion of plastic waste into energy, and consumer education and training, which have proven to be catalysts for circular plastic economies in developed nations, were assessed for their applicability within the Nigerian context and found to be suitable. These findings pave the way for future endeavors aimed at advancing sustainability and responsible plastic management practices in Nigeria.

## 5.2 RECOMMENDATIONS

**Recommendations in the Nigerian context**

Some of the recommendations the researcher would propose in the Nigerian context is as follows:

**Strengthen Regulatory Frameworks**: Enhance and enforce regulations related to plastic waste management, recycling, and sustainable practices. Develop clear policies and incentives to promote circular economy initiatives, including plastic-to-energy projects.

**Invest in Infrastructure**: Invest in waste collection, sorting, and recycling infrastructure to support the efficient management of plastic waste. Promote public-private partnerships for the development of recycling facilities and waste-to-energy plants.

**Promote Research and Innovation**: Allocate resources to research institutions and universities for innovative solutions in plastic waste conversion and recycling technologies.Support research into alternative, eco-friendly materials to reduce plastic consumption.

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