



Managing plastic waste crisis in Kenyan urban centers with the circular economy approach

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ABSTRACT

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The objective of the study was to explore how plastic waste management crisis in Kenyan urban centres can be addressed sustainably through circular economic approaches. Kenyan urban centres are faced with plastic waste challenges which includes environmental pollution, water trenches blockages, causing animal and human health impacts. Despite the measures taken by the Kenyan national and county governments such as banning of single use plastic bags and sustainable waste management policies, there is a need to explore on the legal and policy framework for sustainable plastic waste management Kenyan urban areas. In addition, the study seeks to understand the consumers' behaviour and attitudes to plastic waste management.

The purpose of the study was to use both quantitative and qualitative research methods to blend the results for better understanding of the research question. In the quantitative part of the research, a structured questionnaire was used to collect data on the three areas of study which are the circular economic initiatives used in managing plastic waste, the legal and policy framework and the consumer's behaviour and attitudes in plastic waste management. Statistics Package for Social Sciences (SPSS) was used in descriptive analysis of the study. Qualitative part of the research was based on ethnographic observation and relevant legislative literature. Content analysis was used to explore the thematic areas of study observed and literature.

The results indicated that circular economic approaches such as the application of 5Rs (Reuse, Repair, Recovery, Recycle and Redesign), are present in community-based organisations and private business sector. However, many plastic wastes still end to landfills and open dumping. Despite the many regulation measures being taken by Kenyan national government, there is no legal framework specifically for plastic waste management in Kenyan urban centres. Plastic management in Kenya has no clear structure both in national and county level. Consumer's behaviour of littering plastic waste and lack of plastic waste separation is a key challenge in embracing sustainability to plastic waste management in Kenyan urban centres. Although bans of single use plastic waste have led to increased awareness in the impacts of plastic waste, there is less awareness on applying sustainable approaches to plastic waste management.

Key words: plastic, urban centres, circular economy, consumers

CONTENTS

1	INTRODUCTION	6
1.1	Statement of the problem	6
1.2	Research Objective	10
1.3	Research Question	10
1.4	Purpose of the study	10
1.5	Limitation of the study	11
2	LITERATURE REVIEW	12
2.1	Impact of plastic wastes in urban centers globally	12
2.2	Impact of plastic wastes in the Kenyan urban centers	13
2.2.1	Impact of plastic waste in Mombasa City, Kenya.....	15
2.2.2	Impact of Plastic waste in Nairobi City, Kenya	16
2.3	Legislation and regulations in support of circular economy in Kenya.....	18
2.3.1	Environmental Management and Coordination Act (EMCA) of 1999.....	18
2.3.2	National Environment Management Authority (NEMA) Act of 1996.....	19
2.3.3	E-Waste Regulations (2019)	19
2.3.4	Extended Producer Responsibility (EPR) Framework	20
2.3.5	National Policy on Sustainable Solid Waste Management in Kenya (2016)	20
2.4	Plastic waste management and circular economy in Kenya	21
2.4.1	Plastic Recycling initiatives.....	23
2.4.2	Public awareness and education programs about circular economy	24
2.5	Consumer's behavior and attitudes in plastic waste management.....	25
3	RESEARCH METHODOLOGY	28
3.1	Research Design.....	28
3.1.1	Quantitative research method	28
3.1.2	Qualitative research method.....	29
3.2	Data collection Methods.....	29
3.2.1	Quantitative data collection methods.....	29
3.2.2	Qualitative Data Collection	29
3.3	Sampling Methods	30
3.3.1	Quantitative sampling method	30
3.3.2	Qualitative sampling method	31

3.4	Sampling Size	31
3.5	Sampling Frame.....	31
3.6	Data Analysis Techniques.....	32
3.6.1	Surveys	32
3.6.2	Documentary Analysis Tools	33
3.7	Ethical Considerations	33
4	DATA ANALYSIS.....	34
4.1	Quantitative data analysis	34
4.1.1	Plastic waste and circular economy in the Kenyan urban centers quantitative data results	35
4.1.2	Legal and policy framework quantitative data result analysis.....	38
	Consumer's behaviour and attitude quantitative data result analysis	39
4.2	Qualitative data analysis	45
4.2.1	Qualitative data analysis of circular economy in plastic waste in Kenyan urban areas.....	45
4.2.2	Circular economic industries in plastic waste management in Kenyan Urban Centers, qualitative data analysis.....	48
4.2.3	Consumer's behaviour and attitudes to plastic waste management in Kenyan urban areas qualitative data analysis and presentation.	51
5	DISCUSSION	54
5.1	Discussion on quantitative data.....	54
5.1.1	Circular economic approaches to plastic waste management.....	54
5.1.2	Legal and policy framework.....	55
5.1.3	Consumer's behaviour and attitudes towards plastic waste.....	56
5.2	Discussion on qualitative data.....	57
5.2.1	Circular economic approaches and plastic waste management in Kenyan urban centres	58
5.2.2	Policy and legal frameworks in plastic waste management.....	59
	Consumer's behaviour and attitude in Kenya urban areas.....	60
5.3	Conclusion	61
5.4	Recommendations	62
	REFERENCES	64
	APPENDICES.....	71
	Appendix 1. Questionnaire.....	71

ABBREVIATIONS

CBA	Consumer's Behaviour and Attitudes
CEA	Circular Economy Approaches
EMCA	Environmental Management and Coordination Act
EPR	Extended Producer Responsibility
EU	European Union
LPF	Legal and Policy Framework
NEMA	National Environmental Management Authority
PET	Polyethylene Terephthalate
UNCTAD	United Nations Conference on Trade and Development
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organization
VAT	Value Added Tax

1 INTRODUCTION

1.1 Statement of the problem

Globally, plastic production has been increasing with the increase of the demand in mass production of various products. Today, there is high amount of plastic produced without proper waste management practices and this has been linked to an increased detrimental effects on terrestrial and aquatic life, climate change, human health and the environment (Njoroge, Nikam and Ddiba 2022). This has led to plastic waste leakage and pollution as the key political agenda in Europe and across the world. This reinforces the need to have more innovative sustainable plastic waste management solutions with better management policies and legislative measures. Without proper plastic waste management, it is estimated that 12 billion Mt of plastic waste will be disposed to natural environment and landfills by 2050 (Geyer, Jambeck and Law, 2017).

Circular economy principles are becoming hand in the search for plastic waste management solutions. Implementation of circular economy approaches has proven to be a better way of addressing plastic waste. "Prioritizing waste prevention, reuse, recycling and recovery of materials and energy over disposal through landfilling, offers the waste hierarchy approach a sustainable pathway to the management of municipal solid wastes and realization of a circular economy" (Kituku *et al.*, 2020).

Global awareness of plastic pollution has grown in recent years (UNEP 2018), and several countries have passed legislations to ban or impose economic instruments to control the production, distribution, and use of this category of plastics (Oguge 2021). However, these measures alone may not provide a sustainable solution for plastic waste since there are other sources of plastic waste especially from packaging industry which end up in landfills and dumping sites.

Many plastic wastes come from the packing industry after the end of life, although packaging industry uses other materials in packaging, it is the leading source of plastics. While plastics serve many benefits to our daily lives, they also have setbacks to the environment, economy, and negative human health effects. Linear

economy has failed to address social, economic, and environmental impacts of plastic waste since plastic waste pollution has great negative environmental, and social economic repercussions.

However as explained by Szky (2019), circular economy provides an alternative solution since it is more regenerative whereby plastic waste can be reduced through circulation of plastics, reusing of plastics, and recycling of the plastics. Application of circular economic approaches in plastic waste management is more advanced in developed countries as compared to developing countries and it is now emerging as alternative economic model to linear economy in curbing of the plastic waste. Circular economic principles aim at redesigning products to ensure social, economic and environmental wellbeing through circulation of material flows (Meys *et al.*, 2020). Circular economy model is defined as an economic model which provides alternative to the 'end-of-life' concept by reusing, reducing, recycling, and material recovery in a product life cycle. Circular economy helps to reduce overexploitation of limited natural resources by ensuring multiple mechanisms of generating new value (Koech and Munene 2020).

While linear economic model is defined by Ellen MacArthur Foundation as an economic model where we take materials from earth, make products from them, and eventually throw them away as waste. This model has at least three downsides, whereby first, every time we produce a new final product, we require materials and other resources like energy which makes production intensive and costly. Secondly, any waste thrown away generates adverse environmental impacts and thirdly, the overall process results to an unsustainable and less resource efficient production system (Arthur *et al.*, 2022).

However, moving to circular economy is beneficial since it promotes sustainability, jobs creation, protecting the environment, and emissions reduction (Kryshtanovych *et al.*, 2020). EU member countries have been leading in the transition from linear economic model to circular economic model and many of the EU countries have an already existing circular economic system to address waste management challenges. According to Mazur (2021), countries with advanced circular economy systems in Europe are Germany, Belgium, Spain, Italy, and Netherlands. The EU through the European Commission has taken several

measures to promote and enhance circular economy. The measures in relation to plastic waste management are banning single-use plastics, improved legislation on preventing plastic waste generation, and better monitoring of the circular indicators in its member states.

In 2018, the European Union adopted the “European Strategy for Plastics in a Circular Economy” (European Commission 2018) which had the objective of transforming the way plastic products are designed, used, produced, and recycled in the EU. Based on this strategy, several EU member countries have a well-developed circular solid waste management system, whereby plastic waste forms part of the solid waste. Many developed countries have already taken several policies and legal measures aimed at reducing plastic waste disposal through a linear economic model. In the developing countries plastic waste management practices vary from one region to another as explained by Joshi, Seay and Banadda (2019). They highlight main reasons of poor plastic waste management are due to lack of financial resources, undeveloped waste collection infrastructures, lack of population awareness on the effects of poorly managed wastes and governance challenges which affect implementation of policies and legislations.

In Kenya, millions of plastics are consumed monthly whereby half of these end up in the solid waste stream (Njeru 2006). In Kenya’s capital Nairobi, it is estimated that 2,400 tons of solid waste are generated daily, 20% of which is plastic (Khamala and Alex 2013). In Mombasa city, out of the total approximately 19000 tons of waste generated per month, 10% is plastic waste as reported by (Khamala and Alex 2013). In 2017, Kenya implemented a ban on the production, importation, and use of single use plastic bags plastic bags with a thickness of 30 microns with limited specific cases such as hospital and duty-free shops. The ban of single use plastic bags was influenced by the underdeveloped waste management system coupled with illegal dumping of waste in the residential areas as Omondi and Asari (2021) discusses. Poor disposal of plastic waste is responsible for seasonal flooding which often creates breeding grounds for mosquitos, reduced water percolation and aeration in the soil, water pollution, blockage of the drainage and waterways, (Horvath, Mallinguh and Fogarassy 2018). In addition, poor plastic waste management leads to increased risks to the environment and human health.

The ban of single use plastic bags paved way for a road map to reduced plastic use in Kenya (Horvath, Mallinguh and Fogarassy, 2018). However, the ban has its associated challenges which include: the ban did not include other types of plastic waste apart from the single-use- plastic bags. This clearly meant, the ban only reduced the amount of plastic waste to the restriction of plastic bags. As part of the critical review of banning use of single- use- plastic bags, Kenya did not give a clear road map to address the already existing plastics waste challenges in the environment (Geyer, Jambeck and Law 2017).

In addition, the implementation of this regulation has faced some unforeseen challenges in terms of implementation due to lack of a clear system of implementation and accessibility of alternative bags in the market immediately after the ban. Thus, still plastic waste poses a major challenge to waste management in Kenya according to (Horvath, Mallinguh and Fogarassy 2018).

Plastic waste management challenge is more prominent in Kenyan towns as compared to rural areas and this is mainly because of high population density in Kenyan towns with poor urban planning and poor waste management by the town municipal councils (Henry, Yongsheng and Jun 2006). The range of plastics products which are common are drinking bottles, secondary packaging plastic bags, disposable food packaging containers, and other goods made from plastic materials (Oguge 2019). Despite the plastic waste challenge, there has not been any plastic waste management legislation until in 2022 when Kenya enacted Sustainable Waste Management Act (No. 31 of 2022), legislation which aims to extend the responsibility of producers over their products and packaging throughout their entire life cycle. From the literature, it is evident that there are no formalized plastic waste management systems in Kenya, except some few communities based and private plastic waste through recycling and other circular economic approaches.

Kenya is therefore struggling with plastic waste which forms part of waste management since all the waste in Kenya are mixed and usually disposed in dumping sites. It is worthy to note that, Kenya is using open dumping area which is regarded as dumping site (Kimani 2021). It is against this backgrounds that this

research would like to explore on how Kenya can manage plastic waste crisis using circular economic approaches in the urban centers. The research will assess the consumers' behavior and attitudes towards plastic waste in the Kenyan urban centers.

1.2 Research Objective

The research objective is to explore how to manage plastic waste crisis in the Kenyan urban centers through circular economic approaches.

1.3 Research Question

How can Kenyan urban centers manage plastic waste with the circular economic solutions?

In answering the research question, the following specific research questions will be answered in this research.

1. What are the circular economic approaches used in addressing plastic waste in Kenyan urban areas?
2. What is the legal and policy framework for circular economy and plastic waste management in Kenyan urban centers?
3. What is the consumer's behavior and attitude towards plastic waste in the Kenyan urban areas?

1.4 Purpose of the study

The purpose of this study is to explore how plastic waste can be managed in Kenyan urban centers through circular economy approaches. It delves into urban plastic waste impacts and explores alternative circular economy approaches in managing the crisis in the Kenyan urban centers. It also aims at assessing the consumers' attitude and behavior towards plastic waste in the Kenyan urban centers.

The research findings will be essential in understanding the level of plastic waste management and some of the sustainable measures Kenya is taking in curbing plastic waste pollution in the urban centers through circularity. The research findings will be valuable to the Kenya government and plastic waste management stakeholders who are interested in addressing plastic waste through circular economic approaches.

1.5 Limitation of the study

The study was carried out in the Kenyan urban areas and therefore, the research findings are only limited to the Kenyan urban areas due to the wide scope of the study. The research also used ethnographic research method as part of the qualitative research, thus having a potentiality of being biased. However, this was well mitigated by using qualitative study to give a more insight and understanding of the study.

2 LITERATURE REVIEW

2.1 Impact of plastic wastes in urban centers globally

The rapid growth of population globally is causing unexpected immigration from the rural areas which are resulting in the growth of squatters and informal housing, to rapidly expanding cities thus more urbanization (Vij 2012). Urbanization according to Davis (1965) is an index of transformation from the traditional rural economic industrial one. Vij (2012) explains that urbanization directly contributes to waste generation which if not well handled can cause health hazards and urban environmental degradation.

Waste management is emerging as one of the major challenges of urbanization and if not well addressed in a sustainable way, it is likely to cause further environmental degradation, health risks, emissions of toxic gases and carbon footprint (Chan 2022). Non-biodegradable plastic waste is attributed towards causing waste management problems and choking of the drains in urban centers Plastic waste becomes pollutant in form of litter, fragments, bags macro plastics, mega-debris, and nano-plastics (Li *et al.* 2021). Such kind of environmental impacts are more prominent especially where water bodies are near urban centers with poor plastic waste management systems.

With the increasing urbanization in the 21st century, sustainable and resilient urbanization is critical in protecting natural environment, human wellbeing and the society (Kaur and Garg 2019). Sustainable urbanization incorporates urban planning and development model "which meets the need of the present needs without compromising the ability of the future generations to meet their own needs" (Brundtland 1987). It emphasizes three pillars of sustainability which are environmental, economic, and social equity. Therefore, sustainable urbanization and environmental protection are inherently intergraded and plastic waste management needs to be done in a sustainable way to achieve sustainable development goals (SDG 2015).

While plastics have many benefits, the negative consequences to the environment and the ecosystems are catastrophic. For instance, “with more million metric tons of new, virgin plastic produced globally per year, only 14 percent of all plastic packaging is collected for recycling” (Szak 2019,55). When considering the value losses in sorting and reprocessing, only 5 percent of the material value is retained for the next use from the single use plastics (Szaky 2019).

Globally, several countries are now taking several measures to manage plastic pollution through sustainable circular economic approaches. In a comparative study of solid waste management which involved 20 cities, Wilson *et al.* (2012) says that many cities across the world are deploying a wide variety of ideas to overcome challenges of plastic waste management. Some of these ideas are innovative methods, some are drawn upon traditions; some which are immersed in local culture and habits, others aim at changing habits and attitudes (Roda 2010).

In achieving environmental sustainability and transition from linear economy to circular economy, it highly relies on effective waste management and how waste is treated as a potential future resource (Payne, McKeown, and Jones 2019). Many countries around the world are faced with the challenge of waste management, as they aim to build a conducive and sustainable environment in the cities or urban centers. There is need for responsible plastic waste management other than the linear model where people care less about the end of life to the plastic materials (Milios, Esmailzadeh, Davani and Yu 2018).

As plastic production and use has grown globally, plastic waste has also grown over the years. Plastic production in the world reached a staggering 390.7 million metric tons in 2021 (Statista 2023). The soaring production of plastic is linked to the human population increase, urbanization, economic growth, and lifestyle changes causing an increased in demand of plastics (Zhang 2022).

2.2 Impact of plastic wastes in the Kenyan urban centers

In Kenya, plastic product manufacturing has steadily grown with more than 100 companies manufacturing plastics products (Njoroge, Nikam and Ddiba 2022). Many of these manufactured plastics products are used in packaging industry

within Kenya. With an increased packaging plastic production, there is a respective increase of plastic waste coming from packaging industry due to improper plastic waste management in Kenya. More than half of all the plastic waste in Kenya end up in open dumping sites, with 18% being recycled (UNCTAD 2021). Plastic waste management in Kenya is mainly carried out on an informal recycling sector and it involves recovering of recyclable plastic waste by waste pickers from open dumping sites (Griffin and Karasik 2022). The collected plastic waste is then taken to middle business people for sorting and aggregating (Gall 2020). This is commonly done in urban centers since there is no formalized system of waste management in rural areas of Kenya (Pucino *et al.*, 2020).

An urban area in the Kenyan context is define in the 2019 Act of Kenyan Parliament as “an area with a population of at least 250 thousand residents within the recent census report, has area or city development plan, has demographic capacity by its residents in the management of its affairs, has basic infrastructure, and has a capacity for functional and effective waste disposal.” Thus, waste management is one of the functions of the established institutions within urban areas in Kenya. However, based on the literature review, still many towns and cities in Kenya are struggling with the challenge of plastic waste and solid waste management in general due to many reasons which includes limited funding and infrastructures to deal with waste (Sira 2012). Plastic waste presents a significant environmental challenge in urban centers across Kenya. For example, in urban areas like in Mombasa city, Nairobi city, Kisumu city, and other towns in Kenya have challenges in plastic waste management since in Kenya all the solid waste are mixed and taken to a dumping site (Ngunju 2018).

The extensive uses of plastics and inadequate waste management practices in the Kenyan urban centers have led to a range of adverse impacts affecting both the environment and public health (Ziraba, Haregu and Mberu 2016). Studies have consistently highlighted the contamination of water bodies, including rivers and drainage systems, by plastic debris. The subsequent release of micro plastics, formed through the breakdown of larger plastic items, poses a substantial threat to marine life and aquatic ecosystems. Furthermore, plastic waste exacerbates flooding in urban areas as it clogs storm water drains and disrupts the natural flow of water during rainy seasons (Jambeck 2015, Nzoiwu 2018).

Beyond the environmental implications, the accumulation of plastic waste in urban settings has significant public health consequences. The presence of discarded plastic items creates ideal breeding grounds for disease vectors like mosquitoes, increasing the risk of vector-borne diseases, such as malaria and dengue fever, among urban residents. The practice of open-air burning of plastic waste releases toxic fumes and particulate matter into the atmosphere, contributing to air pollution and respiratory issues, particularly for those living in proximity to dumpsites and informal waste disposal areas (Ongondo 2011).

The economic and touristic ramifications of plastic waste are of concern. Urban centers heavily reliant on tourism, such as those in Kenya, experience a decline in their attractiveness due to plastic litter. This aesthetic degradation deters tourists and negatively impacts local economies. The financial burden of plastic waste management, including cleanup efforts and waste disposal infrastructure, diverts valuable resources from essential municipal services, affecting the overall well-being of urban populations (Odhiambo 2014).

Kenya has implemented regulations and bans on single-use plastics to address the plastic waste crisis both in urban and rural areas (UNEP 2018), whereas there is no separate legal framework that is explicitly for urban waste plastic management. However, the literature highlights challenges in enforcing these regulations, primarily due to inadequate facilities for waste collection, transportation and disposal, corruption, and inadequate public awareness and good management practices (UNCTAD 2021). To effectively curb plastic waste generation and promote recycling, there is a growing recognition of the need for stricter enforcement and additional measures, such as Extended Producer Responsibility (EPR) programs (UNEP 2018).

2.2.1 Impact of plastic waste in Mombasa City, Kenya.

Plastic waste has become a growing concern in Mombasa city, Kenya, with profound consequences for both the environment and the well-being of its inhabitants. Research conducted in this urban center has consistently highlighted the extensive environmental pollution brought about by plastic waste (Kamau et al., 2016; Nzoiwu et al., 2018). Water bodies, including rivers, streams, and the Indian Ocean, have been severely contaminated by discarded plastics, posing a dire threat to the marine ecosystem. The accumulation of micro plastics, resulting from the disintegration of larger plastic items, has raised grave concerns regarding the long-term ecological impact on aquatic life.

The implications of plastic waste in Mombasa extend beyond environmental concerns to encompass significant public health risks (Kaza *et al.*, 2018), Ongondo 2011). Inadequate waste management practices and the accumulation of plastic waste have given rise to breeding grounds for disease vectors, primarily mosquitoes, elevating the risk of vector-borne diseases such as malaria and dengue fever among urban residents. Additionally, the widespread practice of open-air burning of plastic waste releases harmful pollutants into the atmosphere, contributing to air pollution and respiratory issues, particularly for those residing near dumpsites and informal waste disposal sites (Nzoiwu 2018).

Mombasa's vital tourism industry faces considerable challenges due to plastic waste (Teshome 2023). The city's renowned beaches, celebrated for their natural beauty and cultural significance, have suffered from plastic pollution, leading to a decline in tourist numbers and affecting local livelihoods. This not only has economic ramifications but also underscores the urgency of adopting sustainable waste management practices to preserve the city's appeal as a tourist destination (Liyala, 2011).

Moreover, research and innovation are vital in finding sustainable solutions to the plastic waste challenge in Mombasa, with efforts exploring the development of biodegradable plastics, alternative packaging materials, and advanced waste management technologies (UNEP 2018).

2.2.2 Impact of Plastic waste in Nairobi City, Kenya

Plastic waste in Nairobi city, Kenya, presents a multifaceted challenge with far-reaching consequences. Studies have indicated that plastic pollution is prevalent in the city's water bodies, including rivers and streams, posing a significant threat to aquatic ecosystems (Lange *et al.* 2018). Moreover, the persistence of plastic waste exacerbates urban flooding during the rainy season, as it blocks storm-water drainage systems (Aurah 2013). The consequences of this environmental degradation extend beyond local ecosystems to include long-term ecological implications due to the presence of microplastics resulting from plastic degradation (Bahri 2005).

Inadequate waste management practices and the accumulation of plastic waste have raised public health concerns in Nairobi City. The favorable conditions created by this waste accumulation, such as stagnant water in discarded containers, have become breeding grounds for disease vectors like mosquitoes, leading to a heightened risk of vector-borne diseases among urban residents, including malaria and dengue fever (Aurah 2013). Additionally, the practice of open-air burning of plastic waste, commonly observed in informal waste disposal areas, releases harmful pollutants into the atmosphere, contributing to air pollution and respiratory issues, particularly for nearby communities as noted by (Lange *et al.* 2018).

The economic and social ramifications of plastic waste in Nairobi City are noteworthy. The city's appeal as a business and tourist destination is affected as plastic litter mars its urban landscape and tourist sites (Lange *et al.* 2018). This decline in aesthetics can deter tourists, impacting the local economy and livelihoods, particularly in areas heavily reliant on tourism. Moreover, the financial burden of plastic waste management diverts resources from essential municipal services and hampers sustainable urban development (Njeru 2006). Therefore, based on the literature, the impact of plastic was so evident and despite enactment of Nairobi County legislative measures, there is still a challenge in managing plastic waste.

There is no structured plastic waste management in Nairobi city, according to (Aurah 2013), all the waste from Nairobi including plastic waste is dumped at Dandora dumping site and open burning are the common garbage removal in

Nairobi. According to the study, there is need for proper management of plastic waste unlike the current situation where we have open dumping site and landfills.

2.3 Legislation and regulations in support of circular economy in Kenya

Kenya has become a proactive proponent of circular economy principles and sustainable practices in recent years. The nation is aware of the pressing need to switch to an economic development model that is more resource- and environmentally conscious (Koech and Munene 2020). To bring about this change, Kenya has passed several laws and regulations that support the circular economy. The legislative framework in Kenya is thoroughly examined in this section, and the research delves into the most important statutes and rules that support the nation's dedication to circularity. Kenya's legal system is crucial in determining the country's sustainable future, from the Environmental Management and Coordination Act of 1999 to the more recent E-Waste Regulations (Pathak and Srivastava, 2019). This section will reveal the effects these regulatory actions in support of circular economy and plastic waste management in Kenya.

2.3.1 Environmental Management and Coordination Act (EMCA) of 1999

Kenya's Environmental Management and Coordination Act of 1999 (EMCA) is a thorough piece of law that provides the framework for environmental management and conservation (EMCA1999). The EMCA includes several laws and programs that focus on different environmental problems. The Plastic Bags (Management and Handling) Regulations, 2017 (EMCA1999) is a major regulation under the EMCA. These rules were put in place to curb the worrying increase in the use of plastic bags in Kenyan environments.

The plastic bag regulations place stringent limits on the manufacture, importation, sale, and use of single-use plastic bags (EMCA1999). By doing so, Kenya not only eliminates a major source of environmental pollution but also stimulates the use of more sustainable packaging alternatives. The regulations are consistent with the circular economy concepts of decreasing waste and improving resource efficiency. Businesses have responded by creating and investing in alternative, reusable, and biodegradable packaging alternatives.

2.3.2 National Environment Management Authority (NEMA) Act of 1996

The National Environment Management Authority (NEMA) Act of 1996 established NEMA as the principal regulatory body responsible for environmental management and protection in Kenya (NEMA Act, 1996). NEMA plays a crucial role in formulating environmental policies and regulations, overseeing their implementation, and providing guidance to industries and businesses.

Within the circular economy, NEMA promotes programs promoting resource efficiency and waste reduction (NEMA Act, 1996). It conducts public awareness initiatives, works with industry players to establish circular economy ideas, and oversees compliance with environmental rules. NEMA's efforts are critical in moving the circular economy agenda ahead by supporting sustainable production and consumption habits across all sectors.

2.3.3 E-Waste Regulations (2019)

The E-Waste Regulations of 2019 represent Kenya's response to the rapidly growing issue of electronic waste (e-waste) (E-Waste Regulations 2019). These regulations mandate that producers of electrical and electronic equipment take on extended producer responsibility (EPR) (Pathak and Srivastava 2019). EPR requires manufacturers to monitor and manage their products' life cycle. The producers are responsible for the waste collection, recycling, and proper waste management at the end of the life cycle of the product.

The E-Waste Regulations not only reduce the environmental risks connected with inappropriate e-waste disposal, but they also encourage a circular approach (E-Waste Regulations 2019). Manufacturers are encouraged to build products that are easily recyclable and modular, allowing precious materials and components to be recovered. By supporting the development of e-waste recycling and refurbishment enterprises, this policy promotes the formation of a circular economy environment.

2.3.4 Extended Producer Responsibility (EPR) Framework

The adoption of the Extended Producer Responsibility (EPR) framework in Kenya is not confined to e-waste but extends to a variety of industries (Omari 2022). Producers are held accountable for their products' environmental impact under EPR (EPR Framework 2022.). They must plan, finance, and implement systems to manage their products properly throughout their life cycle, including end-of-life disposal (EPR Framework 2022).

EPR incentivizes manufacturers to adopt circular design principles (EPR Framework, n.d.). They are encouraged to create products that are durable, repairable, and easily recyclable. This shift towards circular product design not only reduces environmental degradation but also stimulates innovation in manufacturing, leading to the development of more sustainable and resource-efficient products. EPR thus fosters a systemic change towards circularity across multiple industries, including packaging, electronics, and automobiles.

2.3.5 National Policy on Sustainable Solid Waste Management in Kenya (2016)

The National Policy on Sustainable Solid Waste Management in Kenya (2016) is a strategy framework that addresses the issues related with solid waste creation and management (Solid Waste Management Policy 2016). It highlights the importance of waste reduction, recycling, and composting as essential components of a circular economy approach (Solid Waste Management Policy 2016).

Kenya seeks to reduce the amount of garbage sent to landfills by promoting waste reduction at the source and encouraging the recycling and composting of organic materials (Solid garbage Management Policy 2016). This lessens the load on landfills while also preserving priceless resources that can be retrieved and utilized again. To promote a more sustainable and circular waste management system, the policy also includes rules for waste separation at the source and the construction of waste-to-energy facilities (Solid Waste Management Policy 2016).

2.4 Plastic waste management and circular economy in Kenya

Although Kenya does not have a specific legal framework for plastic waste management, the existing legislations and policies supports good practices in plastic waste management including use of circular economic approaches (Oguge 2019). There is no clearly structured framework specifically for managing plastic waste in the current and planned policies and thus a grey area. Even though Kenya is a member of East African Community which has a legal framework for managing plastic waste (Cooksey 2016), its implementations is left to member states who are experiencing capacity challenges in the implementation of this legislation (Deshpande and Srivastava 2023).

In addition, the Kenyan legislation of single-use-plastic bag ban, lacks an explicit clauses and provisions that target plastics, and the scope is not clear within the legislation, which carries the risk of legal challenges and uncertainty (UNCTAD 2021). This clearly shows a legal framework and governance gap for plastic waste management in Kenya.

Plastic waste management in Kenya does not exist in a structured way, there is lack of a clear legal framework specifically for plastic waste, this therefore means that there are no formal governance structures for plastic waste except some informal plastic waste management systems which utilizes circular economic approaches. However, Kenya is addressing plastic waste pollution using 4 major regulatory tools; Single- use-plastic bag ban, improvements to solid waste management, Extended Producer Responsibility (EPR), and administrative and budgetary allocations (Griffin and Karasik 2022).

Furthermore, the National Solid Waste Management Strategy (2014) provides guidelines for sustainable solid waste management in Kenya to ensure clean and healthy environment for all (Muthama, 2021). Although the strategy policy identifies use of the 7Rs (reducing, rethinking, refusing, recycling, reusing, repairing, and refilling waste), it doesn't address plastic waste specifically as Griffin (2022) explains.

However, in the recent time, Kenya's serious plastic waste problem has made the country realize how urgent it is to develop circular economy-based measures. The Zero Waste Strategy suggested in the National Solid Waste Management priorities on waste prevention and focuses on conserving resources and building a circular economy and recommends the establishment of the 4R framework (Walker and Xanthos 2018). These strategies aim not only to curtail the environmental havoc wrought by plastic waste but also to harness the economic potential of recycling, upcycling, and responsible plastic management.

One of the most prominent circular economy initiatives in Kenya was the landmark ban on single-use plastic bags implemented in 2017 (UNEP, 2022). This policy, enforced through the Plastic Bags (Management and Handling) Regulations, brought about a substantial reduction in the utilization and production of plastic bags. Simultaneously, it encouraged the adoption of alternative packaging materials such as reusable bags and biodegradable options, perfectly aligning with the circular economy's fundamental principles of waste reduction and resource efficiency.

Kenya's pioneering implementation of Extended Producer Responsibility (EPR) has resulted in a paradigm change in the country's management of plastics and packaging materials (NEMA, 2017). This novel approach, established in the country's regulatory structure, was created expressly to address the environmental difficulties posed by these materials while also promoting circular economy concepts. According to Maitre-Ekern (2021), manufacturers are accountable for their goods' whole life cycle from design and production to disposal. As a result, producers and manufacturers are now responsible for not just making products that fulfill their intended uses, but also for making sure that these products are collected and disposed of ethically once their useful lives are up.

The incentives for producers in the packaging and plastics industries have changed because of this proactive attitude. Manufacturers are now encouraged to provide packaging that is durable and simple to recycle, in addition to being ecologically beneficial (Griffin 2022). By minimizing waste, maximizing resource utilization, and encouraging the development of items that can be smoothly reintegrated into the manufacturing cycle, this revolutionary change in product design

harmonizes with circular economy concepts. This represents a commitment to environmental stewardship and sustainability.

EPR in Kenya embodies the spirit of circularity, transforming the plastics and packaging industry into a dynamic force for environmental responsibility and resource optimization. As a result, it contributes significantly to Kenya's overarching goals of building a more sustainable and resilient economy while minimizing the environmental footprint of plastic waste.

2.4.1 Plastic Recycling initiatives

Kenya's determination to solving its plastic waste issue has led to plastic recycling business enterprises, which is an essential step in the country's transition to a circular economy (Horvath, Mallinguh and Fogarassy 2018). These business enterprises have grown significantly in recent years, playing a crucial part in the gathering of plastic garbage and its conversion into creative and useful items. However, the process entails the collection of recycle plastic materials from open dumpsites that are passed through the middlemen since plastic waste management in Kenya operates primarily on an informal recycling sector (Gall *et al.*, 2020). Although recycling of plastic waste in Kenya by private actors can be traced from 1980s, lack of clear regulations and policy strategy is the key limiting factor to the growth of the industry (Oguge 2019). This has ensured the informality which is directly associated with social economic issues, environmental, health and safety of the waste pickers.

Beyond the environmental conservation effect, these businesses have a substantial impact on Kenya's socioeconomic structure. They enhance community engagement and local economic growth by creating employment possibilities, especially in areas with high unemployment rates (Njoroge and Ddiba 2022). For example, Dandora dumpsite economic activities supports many livelihoods of people living within the area, plastic waste pickers and plastic recycling business enterprises. According to (Kumar *et al.* 2021) the twin advantage of economic empowerment and environmental stewardship highlights the circular economy's revolutionary potential and places Kenya at the forefront of sustainable resource management.

Kenya's plastic recycling business initiatives signify more than just a response to plastic waste; they represent a comprehensive approach to sustainability. They embody the nation's vision of reducing waste, conserving resources, and nurturing a culture of circularity. As these initiatives continue to evolve and expand, Kenya is making tangible strides toward realizing a circular economy where waste is minimized, resources are optimized, and environmental responsibility is paramount (Li *et al.* 2021).

2.4.2 Public awareness and education programs about circular economy

Circular economy initiatives in Kenya extend beyond regulatory measures; they also encompass extensive public awareness campaigns and educational programs (UNEP, 2018) and fostering a deeper understanding of sustainable practices, particularly regarding plastic usage and waste management. These programs include ways in which plastic waste can be recycled, reused, or redesigned with the aim of creating a clean environment, creating employment opportunities, and reducing exploitation of natural resources for plastic manufacturing.

These comprehensive awareness campaigns are instrumental in raising consciousness among the general populace about the environmental repercussions of plastic waste (UNEP 2018). They illuminate the adverse effects of improper plastic disposal, highlighting the connections between individual actions and broader environmental challenges. By doing so, these initiatives empower citizens to make informed choices, encouraging responsible plastic use, and inspiring more sustainable consumption patterns.

Furthermore, educational programs in Kenya's circular economy endeavors serve as essential tools for effecting lasting change (Muriithi and Ngare 2020). They equip individuals with the knowledge and skills necessary for effective recycling, waste segregation, and responsible consumption. These programs are designed to reach diverse demographics, from school children to adults, ensuring that sustainable practices become ingrained in the collective consciousness. Through education, Kenya is cultivating a culture of environmental stewardship,

one that recognizes the significance of waste reduction and resource optimization in achieving a circular economy.

In sum, public awareness campaigns and educational programs in Kenya complement legislative and regulatory measures by creating a sense of collective responsibility and inspiring behavioral change (UNEP 2018). They serve as catalysts for achieving sustainable consumption patterns, thereby reducing the generation of plastic waste, and advancing the nation's circular economy aspirations.

However commendable these circular economy efforts may be, challenges persist in their effective implementation. Enforcement of regulations remains a concern, and the informal sector still plays a significant role in plastic waste management (Kaza et al. 2018). Addressing these challenges will require sustained commitment from the government, active collaboration with industry stakeholders, and substantial investments in waste management infrastructure.

From the literature, Kenya has embarked on a remarkable journey to combat plastic waste through the deployment of circular economy approaches. Although there are challenges with no clear legal framework and no governance structure specifically for plastic waste management, Kenya is already using legal and administrative instruments in promoting use of circular economic approaches to plastic waste management. The ban on plastic bags, the adoption of EPR, the proliferation of recycling initiatives, and the extensive public awareness campaigns exemplify the nation's unwavering commitment to addressing this pressing environmental issue.

2.5 Consumer's behavior and attitudes in plastic waste management.

Understanding consumer behaviour and attitudes in plastic waste management is a crucial aspect of plastic waste management and taking mitigative measures in plastic pollution (Keiron et al 2023). Numerous studies have explored this subject, shedding light on the factors that influence consumer choices, recycling behaviors, and their overall perception of plastic waste (Jekria and Daud, 2016).

One critical aspect is the relationship between the consumers' attitudes and recycling behavior. A study carried out by Bolder et al (2013) which found out that consumers' recycling behavior is strongly influenced by their attitudes and beliefs. In their study, they found that positive attitudes toward recycling and environmental concerns play a significant role in encouraging recycling practices. This suggests that efforts to promote recycling should focus on shaping and enhancing these positive attitudes.

Psychological factors also play a substantial role in consumer behavior in plastic waste management. De Canio, Martinelli and Endrighi (2021) investigated the psychological factors that affect consumers' recycling intentions. They found that consumers with a keen sense of environmental responsibility were more likely to engage in recycling behavior. This highlights the importance of instilling a sense of environmental responsibility in consumers to drive recycling efforts. Social norms and peer influence are significant factors in encouraging recycling behavior, emphasizing that people are more likely to recycle when they perceive it as normative behavior among their peers. This implies that social marketing and community engagement can be powerful tools to promote recycling. Information and education are vital components of changing consumer behaviors (Chan 2001). The study emphasized the importance of providing clear and accessible information about the environmental impact of plastic waste. When consumers are well-informed about the consequences of their actions, they are more likely to adopt environmentally friendly practices.

Convenience and the availability of recycling infrastructure are factors that affect consumer's behavior. Thøgersen (1999) highlighted that convenient access to recycling bins can significantly increase recycling rates. This underlines the need for well-designed and easily accessible recycling systems. Economic incentives, such as deposit-refund systems, have been shown to positively impact consumers' recycling behavior. Hansen (2012) explored the effectiveness of such incentives in encouraging the return of plastic bottles and containers. Economic incentives can provide tangible benefits to consumers for participating in recycling efforts.

Consumer perception of plastic alternatives also influences their willingness to change behavior. Steg and Vlek (2009) in their research, constructs that consumers are more likely to reduce plastic use if they view alternatives as convenient and sustainable. This highlights the importance of making eco-friendly alternatives accessible and attractive to consumers. Cultural and socioeconomic factors also have a significant role to play in shaping consumer attitudes and behaviors towards plastic waste. Diverse cultures and income levels may have varying priorities and practices regarding plastic waste management. Grønhøj and Thøgersen (2012) have explored these factors, emphasizing the need for tailored approaches in diverse cultural and socioeconomic contexts.

In Kenya, urban consumers are more conscious and aware about the cleanliness related to single-use-plastic bag ban and this has resulted to increased personal initiatives in reducing plastic pollution (Omondi 2020). Consumer' behavior is very crucial in transitioning towards sustainable plastic waste management, the study of Kenyan consumer's behaviors and it can help to identify best intervention mechanisms. There are many different behaviors which people can engage in to reduce plastic waste which includes reducing, reusing, and recycling (EU 2008). These interventions are most likely to be effective if they target specific behavior depending on the people's culture and norms. There is a gap in understanding how Kenyan consumers regard the existing plastic waste management instruments and their impacts since the existing literature only highlights the assessment of the impact of banning single use plastic bags (Omondi and Asari 2021).

3 RESEARCH METHODOLOGY

The research methodology chapter entails the selection of a research design, elucidating what kind of research method was used for this study. This choice is instrumental in framing the research's objectives, as it shapes the methods of data collection and analysis. Furthermore, the methodology encompasses data collection techniques, shedding light on how information will be gathered from primary or secondary sources.

In addition to the practical aspects, the research methodology acknowledges the ethical considerations integral to any responsible inquiry. It addresses issues of informed consent, confidentiality, and the mitigation of potential conflicts of interest, ensuring that ethical standards are upheld throughout the research process.

3.1 Research Design

The research adopted a mixed-methods approach, harmoniously blending qualitative and quantitative research methods to offer a multifaceted exploration of the intricate interplay between Kenya's legislative and regulatory framework and its implications for the management of plastic waste (Wahab, 2012). This was carefully chosen to transcend the limitations of a single methodological approach, allowing for a holistic examination of the subject matter.

In using both qualitative and quantitative data collection methods, this research project aimed to triangulate findings from multiple sources and methodologies. This approach provided a more holistic and robust understanding of the research topic (Hussen 2009), capturing both the qualitative depth of stakeholder insights, while the quantitative descriptive analysis captured the nature of circular economic approaches in plastic waste management in Kenya.

3.1.1 Quantitative research method

The research applied quantitative descriptive research method to obtain raw data from the area of study. This method was important in understanding the situation of plastic waste management through circular economic approaches the urban areas in Kenya. Descriptive research uses surveys or questionnaires to gather information about people, groups, and organizations (Östlund *et al.* 2011). For this study, a questionnaire Appendix (1) was designed to gather information from the Kenyan urban centers.

3.1.2 Qualitative research method

Qualitative research explores and provides deeper insights into real world problems such as plastic waste management crisis. The research design further helps to generate hypotheses as well as further investigations and understand quantitative data. It answers the how is and whys through participant's experiences, perceptions, and behaviors (Tenny *et al.*, 2022). This study mainly utilized ethnographic approach to collect data and information. Ethnographic approach will aid in better understanding of the culture and practices of plastic waste management in the Kenyan urban centers.

3.2 Data collection Methods

3.2.1 Quantitative data collection methods

Quantitative data was gathered through survey method, by administering questionnaires to a diverse range of stakeholders involved in circular economy initiatives in Kenya and plastic waste management. The participants who answered the questionnaire were purposefully chosen to represent different actors in plastic waste management system in Kenyan urban centers. These participants come from government institutions, plastic recycling companies, waste pickers, circular economy professionals and consumers.

3.2.2 Qualitative Data Collection

Ethnographic research data collection methods were applied in collection of data and information. Ethnography has been defined by O'reilly (2012) as method or

set of methods which involves the researcher participating overtly or covertly in people's daily lives for a given period of time watching what is happening, listening what they say, asking them questions and collecting all available data which can help the researcher to carry out the study (Naidoo 2012).

Thus, regarding this study, a period of 4 months was used in data collection by actively participating in forums related to the thematic areas of study, observing, and taking photos, and interacting with the people in the areas of study. In addition, Archival records were collected from government institutions, information from Company websites, reports, and news articles with relevant information.

Observations

Data was collected through observation methods by taking note of relevant data and taking photographs. Covert observation was used in understanding consumer's culture and behavior on plastic waste management.

Observation method was relevant for this research to understand the practical situation and impact of plastic waste in Kenyan urban areas.

Archival record

Relevant policy and legislation documents were obtained from government institutions by downloading from the relevant ministries to understanding the current situation of urban plastic management and circular economy in Kenya. These documents include National Sustainable Waste Management Act of Parliament of Kenya (2019), Nairobi City council Waste Management Act (2015), Ban of Single Use Plastics (2020), Single Use plastic bags ban Act of Parliament of Kenya (2017) Kenyan Constitution (2010), and literature.

3.3 Sampling Methods

3.3.1 Quantitative sampling method

In the quantitative study, purposeful sampling was employed to select key stakeholders in Kenya's environmental and regulatory landscape. These stakeholders

were chosen because of their direct involvement in or influence on the legislative and regulatory framework supporting the circular economy in Kenya. Purposeful sampling also allowed the research in different urban areas in Kenya (Nairobi, Mombasa, Nakuru).

While purposeful sampling is a non-random method, efforts were made to ensure diversity and representation within each stakeholder group to obtain a comprehensive range of insights. The specific number of participants in the urban center was determined based on the population of the city.

3.3.2 Qualitative sampling method

The study used two qualitative data collection methods thus different sampling methods were used for each.

Observation

Observation was conducted through random observation sampling in the selected urban areas in Nakuru, Nairobi, Mombasa towns. The observation was covert whereby the participants were unaware of being observed.

Archival records

Legal and policy documents, reports and literature with relevant study information were selected for analysis.

3.4 Sampling Size

The specific number of participants in each urban area was determined based on the population representation according to the Kenyan 2019 census report. This was to capture a fair representation of respondents within the Kenyan urban centers.

3.5 Sampling Frame

The sampling frame consisted of lists, sources, and databases containing information about key stakeholders involved in plastic waste management and circular economy initiatives in Kenya. They included legal and policy experts, circular economy enterprises in plastic waste, plastic waste pickers and consumers.

3.6 Data Analysis Techniques

Use of Statistical Package for Social Sciences (SPSS) was used in descriptive data analysis for the data obtained in the questionnaires. While observed data was analyzed by selecting relevant study themes, cultural practices, attitudes, and behavior, documentary analysis was used to analyze legal and policy documents, reports, and literature.

3.6.1 Surveys

Surveys were designed and administered through a questionnaire Appendix (1) to a diverse range of stakeholders involved in plastic waste and circular economy initiatives in Kenya. These surveys included questions related to stakeholders' perceptions, attitudes, and practices concerning circular economy regulations and plastic waste management.

Plastic waste management survey in urban areas with approaches to circular economy was carried out with a closed ended questionnaire. The questionnaire was designed such that it covered three sub research questions of the study. The three subsections of the questionnaire were circular economic approaches in plastic waste management, legal and policy framework for plastic waste in Kenya, and the consumer's behaviors and attitudes in plastic waste management. Each of these sub research questions had 5 questions to be answered by the respondents. The survey as discussed in the research methodology was aimed at collecting data from the Kenyan urban centers which are Nairobi, Mombasa and Nakuru.

The number of questionnaires was distributed in accordance with the town population density based on the 2019 Kenyan census report (Kenya National Bureau

of Statistics, 2019). The report shows the urban centers to have the population as follows:

Nairobi has 4.3 million residents (1.4 million households).

Mombasa has 1.9 million residents (378,422 households).

Nakuru has 2.1 million residents (616,046 households).

The total respondent sample was at 40 in all the questions (n=40). Nairobi city 18 questionnaires, Mombasa city 10 questionnaires, and Nakuru city 12 questionnaires. They were all labeled in serial numbers for each urban center.

3.6.2 Documentary Analysis Tools

Document analysis was used in qualitative data analysis. It involved examining relevant documents such as government reports, policy documents, and regulatory materials related to circular economy regulations in Kenya. Tools for document analysis included checklists and coding schemes to systematically extract information and identify key themes.

Observation

Consumer's behavior, attitudes and practices about plastic waste management and embracing of circular economy in plastic waste were noted down in writings. The photos were taken for deep analysis and presentation purposes.

3.7 Ethical Considerations

Ethical considerations in research are fundamental to safeguarding the rights and well-being of participants and maintaining the integrity of the study. In this project, these considerations encompassed obtaining informed consent Appendix (2), which involved providing participants with clear information about the study's purpose and ensuring their voluntary participation. Additionally, measures were implemented to guarantee the confidentiality of participants' responses and data, reinforcing trust and privacy. Addressing potential conflicts of interest further underscored the commitment to ethical research practices, ensuring that the study's objectives were pursued with transparency and fairness, upholding the highest ethical standards in the research process.

4 DATA ANALYSIS

4.1 Quantitative data analysis

The data was collected and tabulated as shown in the tables: Table 1 has data entry concerned with circular economy approaches in Kenyan urban centers, legal and policy framework, and consumer's behavior and attitudes towards plastic waste.

TABLE 1. Tabulated data from the questionnaires.

Statistics		
	N	
	Valid	Missing
CEA_Q1	40	0
CEA_Q2	40	0
CEA_Q3	40	0
CEA_Q4	40	0
CEA_Q5	40	0
LPF_Q1	40	0
LPF_Q2	40	0
LPF_Q3	40	0
LPF_Q4	40	0
LPF_Q5	40	0
CBA_Q1	40	0
CBA_Q2	40	0
CBA_Q3	40	0
CBA_Q4	40	0
CBA_Q5	40	0
CBA_Q6	40	0
CBA_Q7	40	0
CBA_Q8_1	40	0
CBA_Q9_2	40	0
CBA_Q10_3	40	0

STATISTICAL INTERPRETATION

CEA_Q1-5= CEA is the serial number used to represent circular economic approaches in Kenyan urban center questions while Q1-5.

LPF_1-5= LPF is the serial number for questions for questions on the category of legal and policy frameworks, with Q-1-5.

CBA_1-10= CBA is a serial number representing consumer's attitude and behavior category of questions. While Q1-10

N Valid = Shows the number of questions answered.

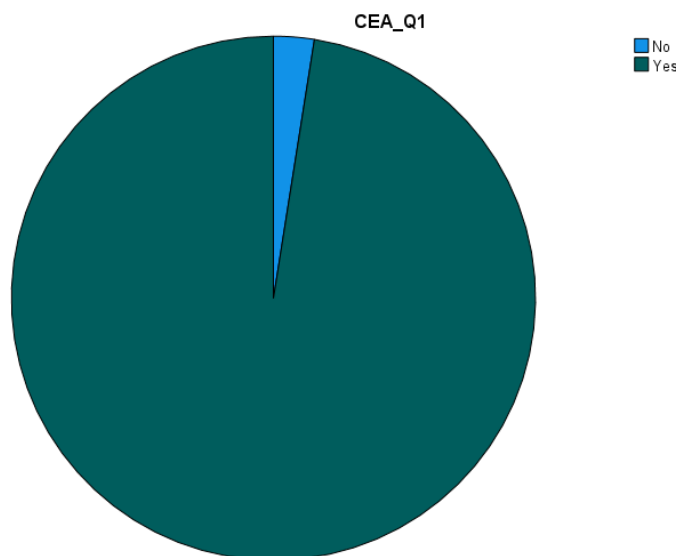
N Missing= Shows the missing or unanswered question.

The results were analyzed in terms of the frequencies and percentages and recorded in the tables. Graphic representation has been used to illustrate and simplify the data as shown in the subsequent chapters.

4.1.1 Plastic waste and circular economy in the Kenyan urban centers quantitative data results

The result from the questionnaire shows that there is a lot of awareness in use of circular economic approaches in the Kenyan urban centers. High percentage 97.5% of the respondents said yes, they are aware of plastic waste management through circular economic approaches. The results can be shown in figure 1. In figure 1, CEA-Q1 means Circular Economy Approaches Question 1. (Yes), are those who are aware while (No) represents those who are not aware of circular economic approaches in kanya urban centres.

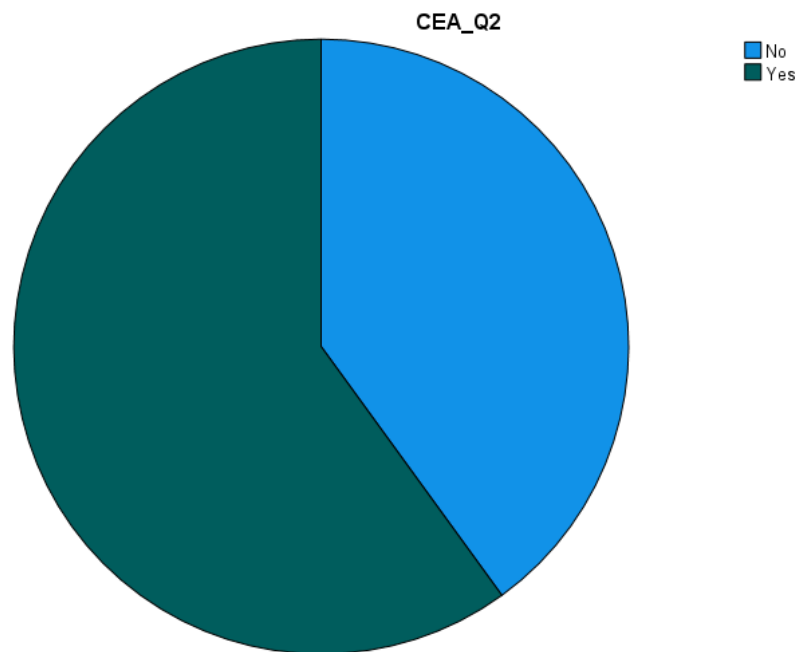
FIGURE 1. Frequency results in percentage of those who are aware of circular economic approaches in the Kenyan urban centers.



In the results, 60 percent of the respondents said they have participated or benefited from initiatives of plastic waste and circular economy while 40 percent have not participated or benefited. This can be shown in figure 2 below in a pie chart.

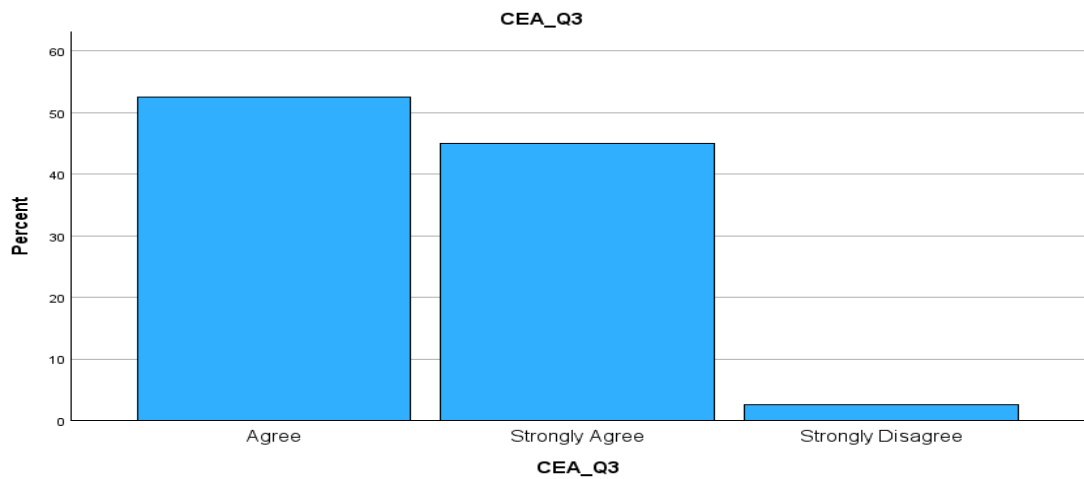
In figure 2, CEA-Q2 means Circular Economy Approaches Question 2. Yes, represents those who have participated or benefited while No are the responds who have not benefited or participated.

FIGURE 2. A frequency of the respondents who have benefited or participated in a circular economy initiative on plastic waste.



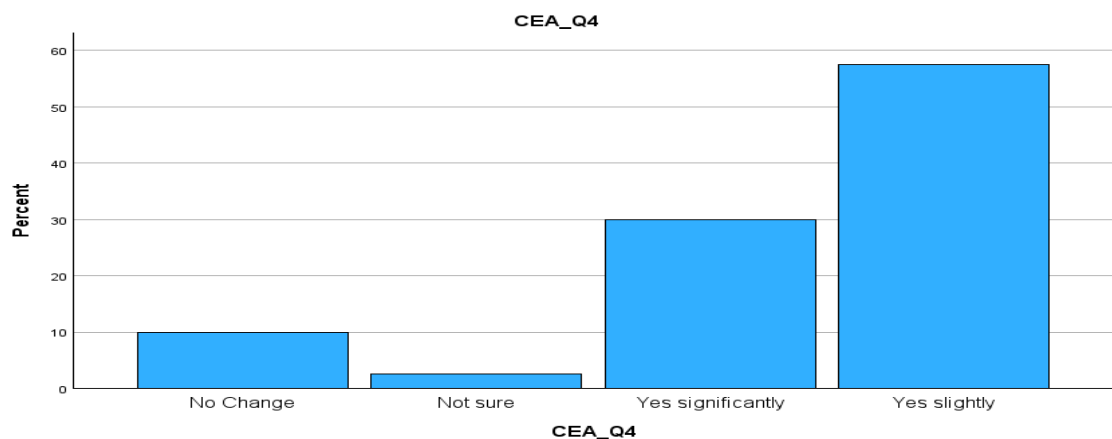
When it comes to if plastic waste in urban centers can be managed through circulation and other circular economic approaches such as recycling reusing, and elimination of non-recyclable plastic materials within the economy, the research shows 52% of the respondents agree, 45% strongly agree while only 2.5 % who disagree. The data is shown in figure 3. In figure 3, CEA-3 means Circular Economy Approaches Question 3.

FIGURE 3. Frequency percentage of those who believe circular economy can effectively reduce plastic waste and promote sustainability. It shows those who agree, strongly agree, and disagree.



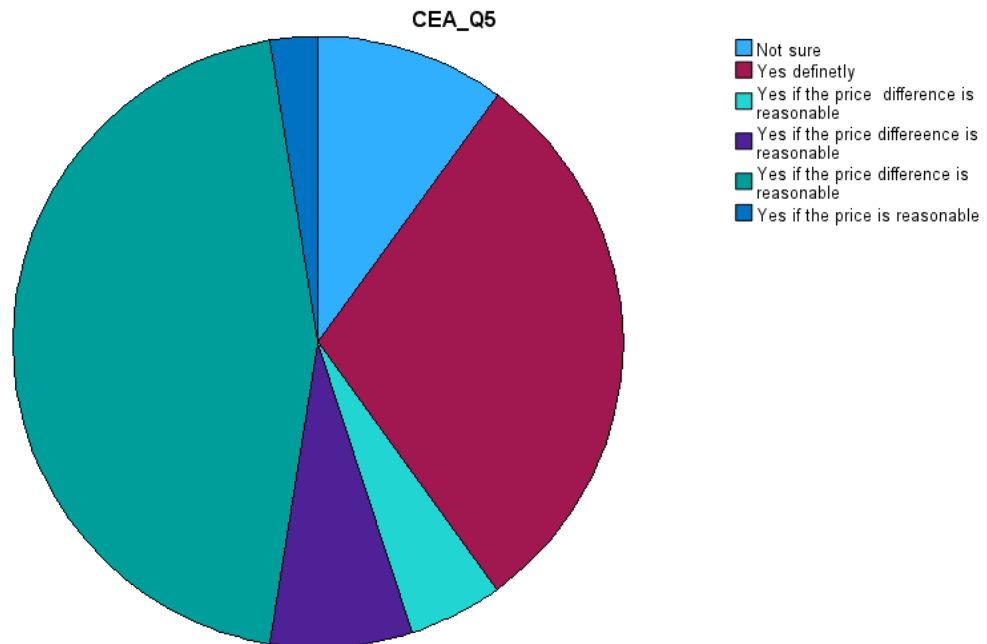
The research wanted to understand if there were increased availability of eco-friendly and recycled products to the consumers in urban areas due to the ban of single use plastic bags in Kenya 2017. The results show 57% who responded by saying yes there was a slight increase, 30% agreed that there was a significant increase in the market change. The results are shown in figure 4. In figure 4, CEA-4 means Circular Economy Approaches Question 4.

FIGURE 4. The frequency percentage of who noticed an increase in the availability of eco-friendly and recycled products in their areas due to circular economy efforts.



On the other hand, 45% of the respondents were willing to support businesses which embrace circular economic principles even if their products were slightly expensive, 30% saying that they will support them. Figure 5 shows the results of the response. In figure 5, CEA-Q5 means Circular Economy Approaches Question 5.

FIGURE 5. The percentage frequency response of those who are willing to support businesses that embrace circular economy principles, even if their products may be slightly more expensive.



4.1.2 Legal and policy framework quantitative data result analysis

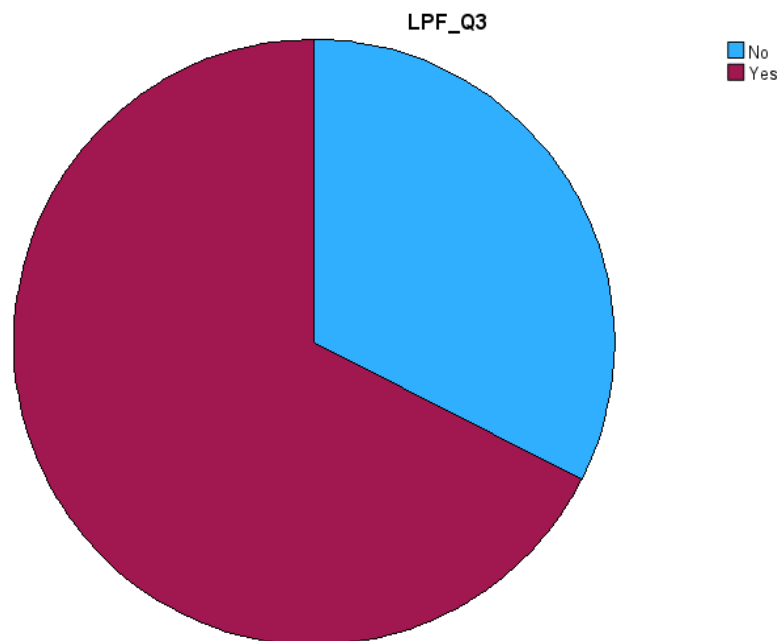
The survey as carried out by the questionnaires was able to induce information and knowledge awareness on the existing plastic waste management regulations, the policies on plastic waste and circular economy, and their influence on adopting sustainable business practices on plastic waste management.

Based on the study results, 92.5% of the respondents agreed of being aware of the existing regulations concerning plastic bags. Only 7.5% were not aware of the law. In terms of the decline of the use of plastic bags, 95% agreed that they had seen a decline of single-use plastic bags which were banned in 2017.

The research results show that 67.5 % of the respondents think that plastic waste regulation has influenced better disposal and recycling of plastics while 32.5 % do not see any influence of plastic regulations and better plastic disposal in

Kenya. This can be shown in figure 6. In figure 6, LPF-Q3 means the Legal and Policy Framework Question 3.

FIGURE 6. A percentage frequency of the respondents who think that plastic ban regulation has influenced the disposal and recycling of plastic waste in Kenya,



According to the study result, 82% believe the Kenyan government need to improve on the plastic waste management legislations, especially on the legal framework.

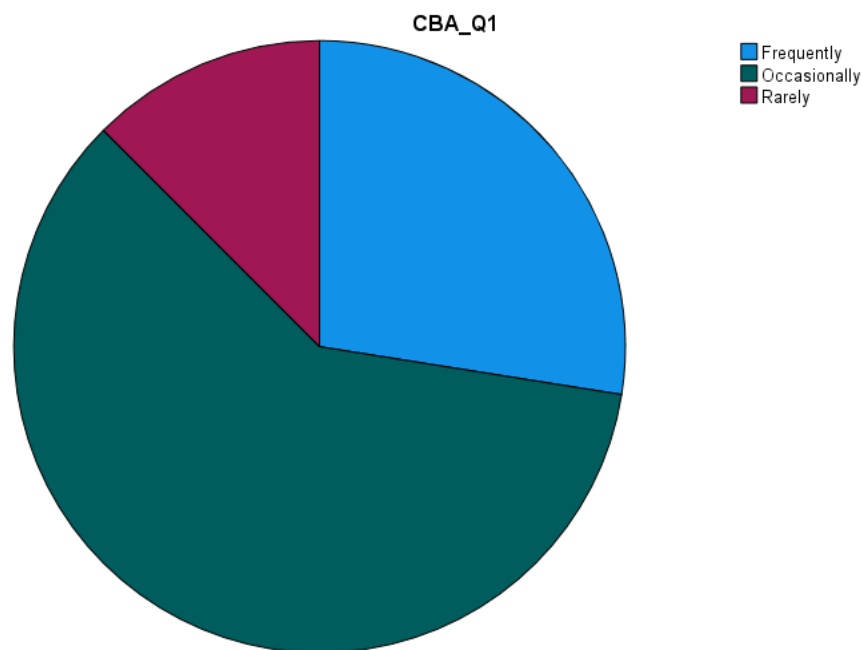
Finally in the legal and policy section, 77.5% of the respondents agreed that they have seen businesses adopting sustainable practices due to regulatory changes.

Consumer's behaviour and attitude quantitative data result analysis

The research questionnaire had 10 questions which were cutting across the consumer's behavior and attitudes thematic areas in plastic waste management in Kenya.

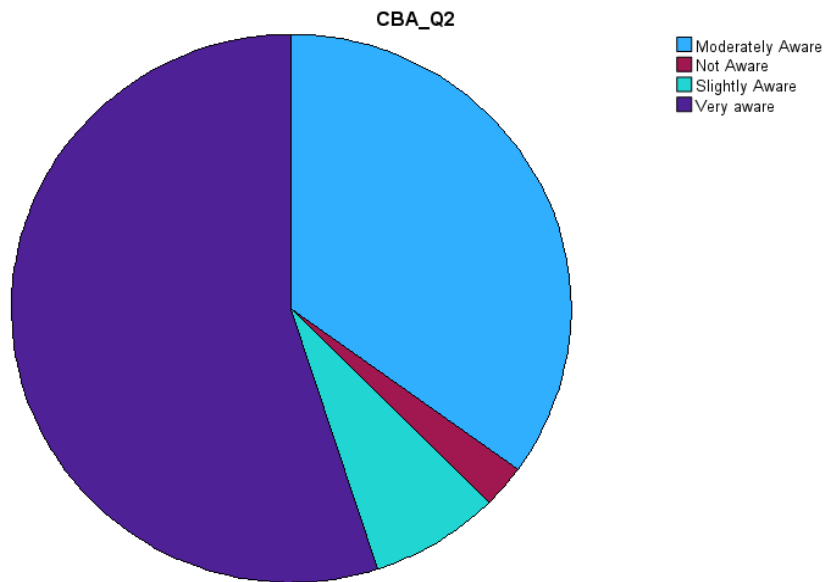
The research results indicated that 60% of the respondents representing the consumers were still using Single-use plastic bags occasionally. 27.5% of respondents agreed that they use plastic bags frequently while only 12.5 were not using them at all. The results can be shown in figure 7. In Figure 7, CBA-Q1 means Consumers Behaviors and Attitude, Question1.

FIGURE 7. The response in frequency percentage of those who use single use plastic products in daily life.



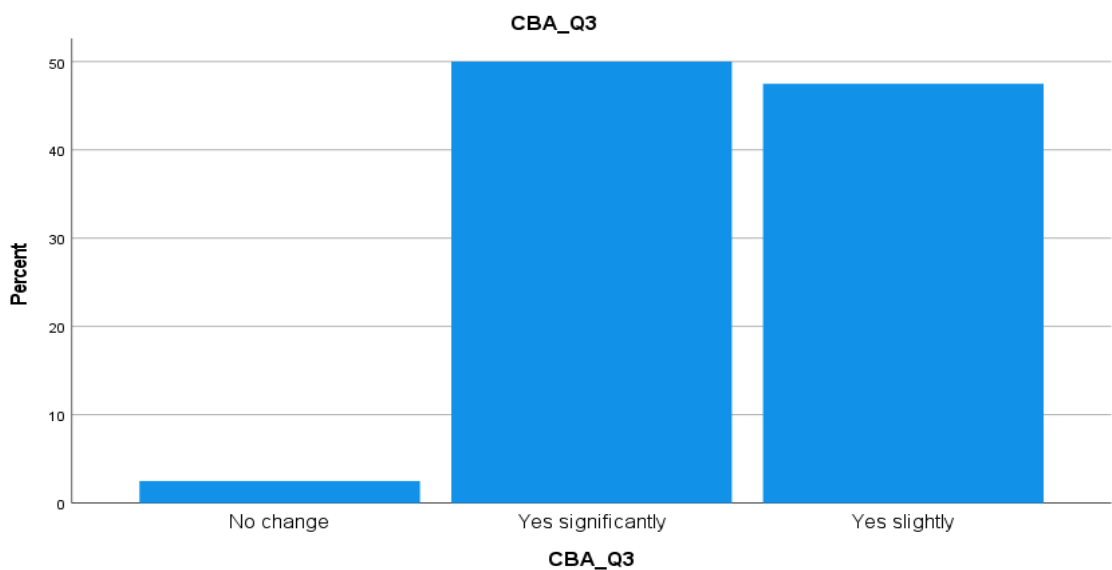
In terms of awareness about the environmental impact of single use plastic bags on the environment and human beings, 55% said they were aware, 35% saying they had moderate knowledge about the topic. Figure 8 shows a pie chart with the results. In Figure 8, CBA-Q2 means Consumers Behaviors and Attitude, Question 2.

FIGURE 8. The percentage frequency to consumer awareness on the impact of plastic pollution in Kenyan urban areas.



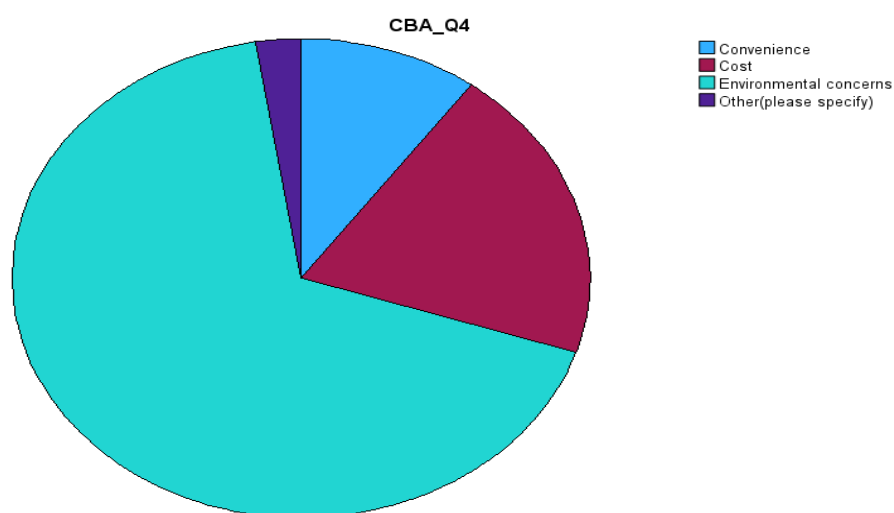
In terms of actively reducing the use of single-use plastics in the past one year, many consumers had reduced with 50% saying they had reduced significantly, 47.5% saying they had reduced slightly. The results show some notable changes in consumer's daily use of single-use-plastics positively. The results can be shown in figure 9. In figure 9, CBA-Q3 means Consumers Behaviors and Attitude, Question 3.

FIGURE 9. a frequency percentage bar chart of those who changed to single-use plastics.



In terms of what influences consumers to use or avoid using single-use plastics, many said it was because of environmental concerns however others had other reasons as shown in figure 9. In figure 10 CBA-4 means Consumers Behaviors and Attitude, Question 4.

FIGURE 10. Percentage response on reasons for using or not using single-use-plastics.



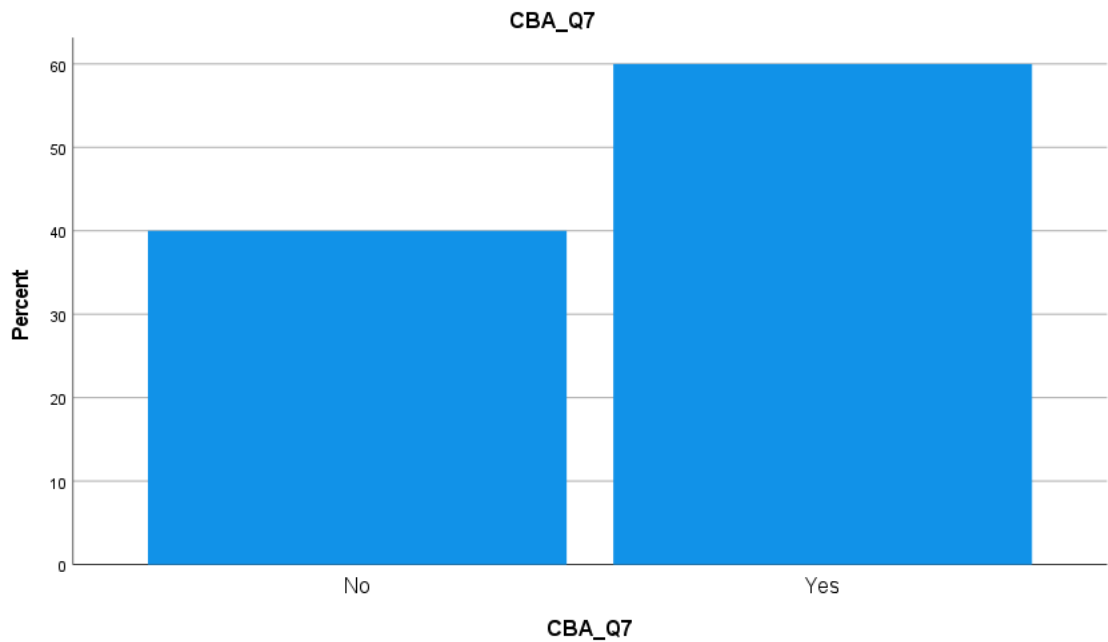
According to respondent results, the study shows 50% said they always reuse plastic bags and containers, 42.5% said they sometimes reuse them while 7.5% said they do not.

Many of the respondents said they believe plastic waste management is a shared responsibility between the government and consumers at 92.5 % percent.

The result shows 60 percent of respondents said they are willing to pay a premium for products that use eco-friendly or recycled packaging material while 40

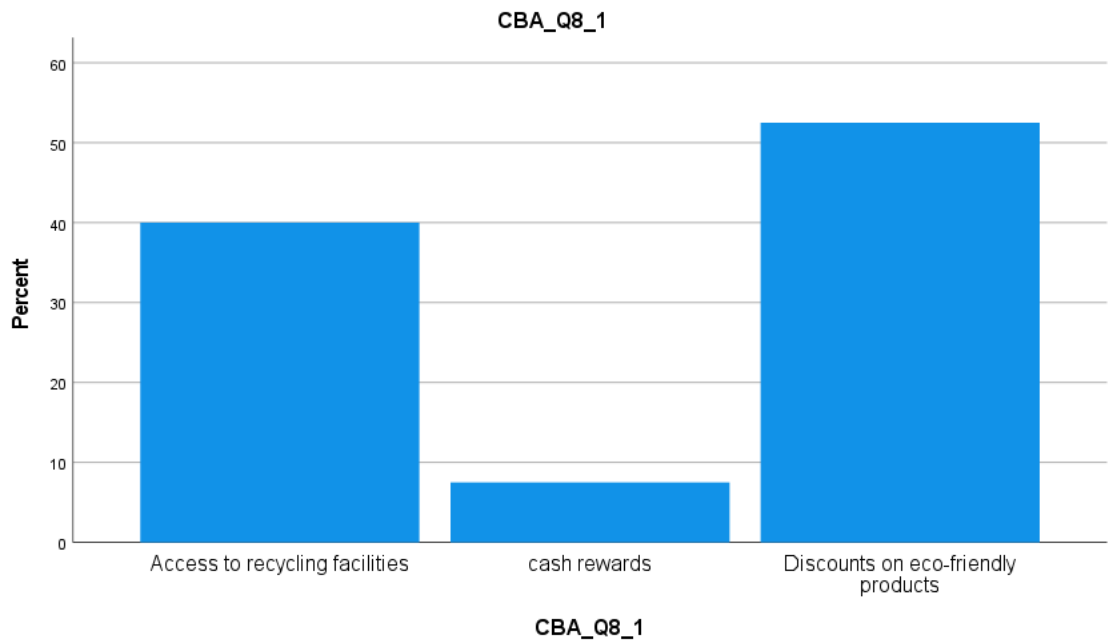
percent are not willing to. This result can be shown in figure 11. In figure 11, CBA-Q7 means Consumers Behaviors and Attitude, Question 7.

FIGURE 11. A frequency percentage bar chart of the results of those who are willing to pay premium for recycled materials or products.



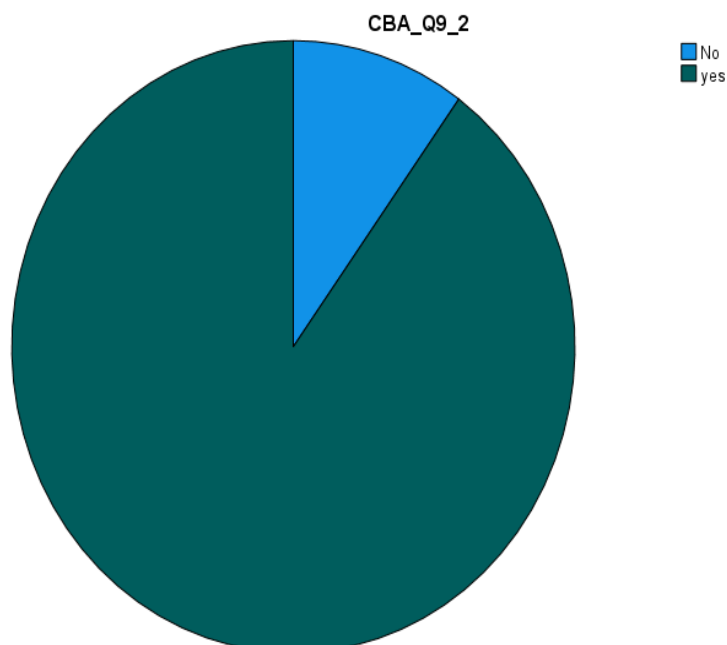
When the respondents were asked what kind of incentives or rewards which can motivate them to recycle more and reduce plastic waste, 52.5 said discounts on eco-friendly products, 40 percent said access to recycling facilities and 7.5 said cash rewards. This result can be shown in figure 12. In figure 12, CBA-Q1 means Consumers Behaviors and Attitude, Question 8.

FIGURE 12. Frequency percentage of responses from the question on what kind of incentives or rewards can motivate one to recycle or reduce plastic waste.



The results show 90% of the response if consumers are familiar with government policies and regulations related to plastic waste management in Kenya while 10 percent said they are not aware of. The results can be shown in figure 13. In figure 13, CBA-09-2 means Consumers Behaviors and Attitude, Question 9.

FIGURE13. A frequency percentage pie chart of the response results of, if consumers are aware of government policies related to plastic waste management.



In the study, the most important question to the respondents was about if they think plastic waste can be effectively managed through circular economic approaches such as through reusing, recycling in a closed loop, the response had varied answers. 40% agreed, 35% strongly agreed, and 22.5% disagreed.

4.2 Qualitative data analysis

4.2.1 Qualitative data analysis of circular economy in plastic waste in Kenyan urban areas

Based on the observation made during the study, it was evident to see plastic waste within the environment. Some plastic waste had blocked water drainage channels while other plastic waste mixed in the dumping site. There was no separation of the waste in many places as evident in the picture 1 and 2 below which shows plastics with mixed waste in a water drainage pathway.



PICTURE 1. Plastic waste disposed in water drainage pathway in Nairobi, Kenya (Getanda 2023).

In picture 2, mixed waste dumped in a nearby bush within a residential estate in Mombasa city. From the picture, someone had attempted to burn some of the mixed waste.



PICTURE 2. Mixed waste thrown near a swamp area in Mombasa coast Kenya (Getanda 2023)

The data collected reinforces the literature and other studies which show that Kenya does not have a developed waste management system for plastic waste, and this leads to illegal and informal mixed waste dumping (Omondi and Asari, 2021). In addition, UNIDO project “Study on available sustainable alternative materials to plastics, and innovative packaging and recycling technologies that meet market needs in Africa to reduce plastics leakages to the environment” (Majale et al, 2016) supports the literature on plastic pollution in Kenyan urban areas. The report presents the study findings which clearly defines the challenge of plastic waste management in Kenya, in addition it also presents the measures which Kenya is already taking to manage plastic waste.

Although there is no specified urban plastic waste management policy or law identified, plastic waste crisis is a national issue which falls within the mandate of National Environmental Management Authority of Kenya NEMA (“Draft_Plastic_Management_Regulations-_05.11_2018.pdf” 2018) in collaboration with the local county governments. Through literature search in the ministry of environ-

ment in Kenya shows there are measures being taken by both the national government and county governments at the aim of managing plastic waste for both urban and rural areas. They include

1. Increase of waste management infrastructure.
2. Free modulation under the (EPR 2022) legislation and taxation
3. Design changes by means of substitution. This is supported by various policy measures in plastic waste management, a circular economic policy.
4. Recycling and upcycling of plastic waste which is included in the Sustainable and Waste Management Act of Kenyan Parliament (2022).
5. Use of bans like for instance the 2017 and 2020 ban of the use of plastic bags and plastics Acts of Kenyan Parliament in specific areas, respectively.
6. Use of incentives in encouraging industrial investment in circular economic companies and industries such as plastic recycling, alternative bio plastic materials. Kenyan government is providing exemption from 16% of value added tax (VAT) for all services in recycling industry for the machines and equipment imported. (Kenya, Ministry of Environment and Forestry 2020).
7. Local county plastic waste management legislations and policies which apply to urban areas such the Nairobi City Council Solid Waste Management Act (2015). The act provides Nairobi County framework for solid waste management and implementation plan; it is in line with the national legislations and prohibits use of plastic bags. In addition, it also provides a plan for waste separation, transportation, and disposal with consideration of recycling process.

It important to note that the Kenyan Constitution Article 69(2), (2010) states that “Every person has a duty to cooperate with State organs and other persons to protect and conserve the environment and ensure ecologically sustainable development and use of natural resources”. This is to emphasize that protection of the environment and sustainable use of natural resources a collective responsibility.

4.2.2 Circular economic industries in plastic waste management in Kenyan Urban Centers, qualitative data analysis

Based on the literature search there is a rise in different approaches of circular economy in plastic waste management in the Kenyan urban areas (Anomat and Ibrahim 2022). Kenya's hub of circularity has been in the informal sector "Jua Kali" whereby plastic materials have been undergoing recovery into useful household items as presented in the assessment report "Kenyan circular economy trends opportunities" (Netherlands Enterprise Agency 2021). The assessment report asserts that the informal sector has been accelerating circularity in Kenya since the 1990s though their impact has been undocumented. However, according to NEMA Executive Director, Kenya recycles only 8-10 % of the plastic waste as of 2023 thus making plastic waste pollution a pressing concern (NEMA: National guidance for plastic pollution hot spotting and shaping action report, 2023).

Through the observations made and data sourced from the literature, there are several recycled and upcycled products from plastic waste within the Kenyan urban areas. An example is Mr. Green Organization (*Mr. Green Africa - Certified B Corporation - B Lab Global 2023*) which deals with organizing plastic waste and other waste picking with established trading points and fix market prices and incentives ('Kenyan Circular Economy trends opportunities' 2023). Baus Taka Enterprise which deals with plastic waste segregation and trading in Mombasa Kenya (*Baus Taka Enterprise – Baus Taka Enterprise 2022*). Green pavers which turn plastic waste to building materials through upcycling whereby they make bricks and posts (Green Pavers 2023). In addition, other enterprises like Takataka solutions are investing in technologies for waste collection, waste separation and better recycling process of plastic waste and other types of solid waste (Takataka solutions 2023).

PETCO is a company name for PET Recycling in Kenya, started in 2018 to represent the Kenya plastic industry's joint effort to self-regulate in post-consumer plastic recycling. PETCO is financed by voluntary EPR fee paid by converters and bottles and on PET resin purchased. The company makes products such as kid's toys made from recycled plastic waste, bricks, fiberfill for duvet and pillows,

PET trays for fruits and many other products (Petco 2023). Picture 3 shows an example of an upcycled product from plastic waste from Gjenge makers Company in Nairobi Kenya.



PICTURE 3. Plastic bricks made from recycled waste plastics (Rain Noe, 2021).

Enterprises and companies involved in plastic waste management in the Kenyan urban centers can be broadly categorized based on the following business models of circular:

Recycle model.

In this circular economic model, plastic waste is recycled enabling partial or total elimination of waste and pollution (Bahri 2005). Some of the products were identified within the urban Kenyan market includes plastics bricks, Ecopost used in fencing and land scaping, post-consumer plastic recycled pellets as presented in an article by (Kenya Recycling: Entrepreneur transforms plastic waste into construction materials, 2019).

Reuse model

Reuse entails using a component or whole product again for the same purpose, which may include cleaning or repairing of the same product before being used. National Sustainable Waste Management Act (2022) of Kenya encourages reuse model of circular economy. The same legislation is also included in the Nairobi County Plastic Control Act (2016).

Through observation made during the research, after the ban of single use plastic bags, many consumers are now reusing plastic containers (Omond and Asari

2021). In addition, some businesspeople have taken this business opportunity by collecting clean plastic containers; they clean and then sell them to the consumers. An example is the Dandora dumping site where plastic waste pickers separate plastic from other solid waste then they are sold back to the companies for reuse or recycling.

Repairing (product extension) model

The interesting part of the research results was an observation in plastic containers repairing which is commonly referred to as (Chomelea). Some residents have taken this as their daily job in helping to repair plastic containers to residents at an affordable cost. This circular economic model is at small scale however and it is engaged by individual entrepreneurs. This model helps to increase the lifespan of plastic containers while using plastic waste as a repairing material. Below in picture 4 shows a repaired plastic water tank by a plastic repairing company as a way of increasing the lifespan of the plastic tank which could be useless after cracking.



PICTURE 4. A repaired plastic tank using other plastic waste (Restore,2023).

Resource recovery model

This model focuses on the end of the usage cycle. Whereby recovering material, energy, and resources from products at the end of use. This model is used by plastic waste recovery companies who utilize waste pickers for recovering plastic waste from mixed waste and sorting them. This is a quite common business

which is practiced especially in urban dumping sites like Dandora dumping site. However, this model has many challenges in the system of plastic waste recovery in Kenya and especially in Nairobi.

4.2.3 Consumer's behaviour and attitudes to plastic waste management in Kenyan urban areas qualitative data analysis and presentation.

Consumer behavior plays a pivotal role in shaping the dynamics of plastic waste generation, disposal, and recycling and redesigning (Islam, et al, 2021). According to consumer behavior in the context of plastic waste was influenced by many factors, including convenience, awareness, economic considerations, regulations, and cultural norms. Understanding these factors was essential in designing effective strategies for plastic waste management. Many consumers have a significant knowledge and awareness of the impact of plastic waste in the urban environment. In the Sustainable Waste Management Act (2022), the legislation extends the integration of waste management into school curriculum to lay strong and waste management practice to the young people. This in addition will promote more research and innovations in the waste management industry where plastic waste forms part of the waste stream.

Based on the observation made in urban areas, it is common for consumers to mix several types of waste and there is no culture of waste separation at the point of origin. This makes it difficult for the plastic waste pickers who use mechanical methods in waste separation in search of recyclable plastic waste. This can be clearly shown in picture 5 below which shows mixed waste which includes plastic waste dumped in one of the waste dumping sites in Mombasa Kenya.



PICTURE 5. Mixed waste at one of the dumping sites in Mombasa Kenya (Getanda,2023).

However, with the EPR Act (2022), it will help transition towards sustainable plastic packing, which will influence the consumer's action to the environment. Under the legislation, it aims to reduce plastic waste as well as accelerating towards 40% recycling rate for plastic packaging by 2030 as outlined by the (Kenya Plastic Pact 2023).

From a study carried out on the effect of the plastic bags ban on consciousness by Omond and Asari (2021), 67% of the respondents supported the ban, 18% did not support it while 15% were neutral. According to the study those who supported the ban were from high income areas and from urban areas in Kenya. The disparity implies that people from urban and high-income areas are likely to comply with plastic waste management policies and laws because of the elevated level of awareness from media houses. Thus, economic levels and access to knowledge and information is very influential in the consumer's behavior change.

The culture of reusing plastic bags is common in Kenya and especially in the Kenyan urban areas as documented in other studies (Omond and Asari 2021). This shows a positive culture of reusing plastic bags among the consumers and awareness has been raised within the urban areas about reusing plastic bags

and containers to limit the amount of plastic waste. Urban consumers have knowledge awareness the effects of improper plastic waste disposal.

5 DISCUSSION

This chapter delves into the heart of the research project, embarking on a discussion that sought to illuminate the key findings and implications drawn from the investigation into plastic waste and the circular economy in the Kenyan urban centers. Building upon the groundwork laid out in earlier chapters, this section provided a platform for a nuanced exploration of the multifaceted dimensions of this research.

This chapter critically revisits areas of inquiry, including emerging circular economy approaches, the legal and policy framework, and consumer behavior and attitudes towards plastic waste. This reflective journey allows the research to draw connections, identify trends, and offer meaningful interpretations that informed the understanding of the complex interplay between these elements.

5.1 Discussion on quantitative data

Based on the quantitative result analysis, the research presents the quantitative discussion from the study findings.

5.1.1 Circular economic approaches to plastic waste management

Based on the study results, there is a lot of awareness in the use of circular economic approaches in the Kenyan urban centres with 97.5% of the respondents agreeing that they are aware. This result was very impressive; however more study might be done in future to understand why there are many people who are aware of circular economic approaches within the Kenyan urban centres.

From the study some of the urban residents in the Kenyan urban centres have benefited or participated from initiatives of plastic waste and circular economy. This result supports the literature on the presence of circular economic business and products within the Kenyan urban centres. However, some people have not benefited from such initiatives. This would mean that the 40 % represents a population where plastic waste and circular economic initiatives have not reached.

This means there is more room for plastic waste and circular economic initiative growth within the Kenyan urban environment.

From the study analysis slightly above half of the population believe circular economy practises such as recycling, reusing, redesigning, and repairing can effectively reduce plastic waste and promote sustainability. While another half strongly agree that circular economic practises one of the solutions to effective plastic waste problem in the Kenyan urban centres. Cumulatively, 97% significantly agreed that use of circular economic approaches can help in managing plastic waste in a sustainable way. Circular economy can help urban management institutions to not only sustainably manage plastic waste but also help in supporting the livelihoods of the people within the urban centres through job creation for those who are engaged in circular economic initiatives.

Through the study results, it shows there is a considerable increase of ecofriendly products and recycled products from plastic waste after the ban of single use plastic bags in 2017. However, since 30% did not agree that there is an increase, it means that some parts of the Kenyan urban areas are yet to see a notable change after the ban of single use plastic bags.

Many people in Kenya urban centres are willing to support businesses which embrace circular economy principles if the price difference with those in linear model is reasonable, while 30% say they will support without much consideration. This clearly shows that prices of products play a significant role in choosing the product at the market.

5.1.2 Legal and policy framework

In terms of legal and policy awareness about plastic waste management in Kenyan urban environment, many people are aware of existing policy and laws as the result shows at 92.5%. This high percentage would be attributed to the 2017 single use plastic bags ban. However, further study might need to be carried to understand their level of awareness and understanding on laws and policies which support better management of plastic waste.

Through the study carried out, it shows the single use plastic bags ban has influenced the way people dispose plastic waste, and especially single use plastic bags 67.5 % of the population in Kenyan urban centres. This shows that use of bans in plastic waste management can influence better positive practises. However, some of the people who live in the Kenyan urban areas have not changed from linear plastic waste practises. Detailed research can be carried out on how the ban has influence and why to some extend it has not been so successful.

According to the study, many Kenyans in urban centres believe there is need to improve the policies and legal framework in plastic waste management. At 82% of the respondents, it clearly shows that the laws and policies need clear formulations or improvement. This study supports the literature that Kenya does not have a specific legal policy or legal framework on plastic waste management.

5.1.3 Consumer's behaviour and attitudes towards plastic waste

Many consumers in Kenya are still using single use plastic including the banned plastic bags. Although the ban of single use plastic bag was enacted in Kenya as from 2017, the ban did not include other single use plastics which therefore means that other single use plastic materials are still in use. The law has a loop-hole to the consumers, in that it allows use of other single use plastics. This shows there is a need for better legal framework and policy which covers a wide rage plastic including all other single use plastic containers. It is for this reason, why many consumers are still using single use plastics. From the study, there are very few people who rarely use single use plastics.

Many urban centre consumers are aware of the impact of plastic waste to the environment and health based on this study. However, many people do not understand the environmental and health implications of plastics, and thus there is need for more public knowledge awareness. Although there is a ban of the single use plastic bags 2017, only half of the respondents said had reduce the use of plastic bags significantly and approximately another half of the population had reduced slightly. This means, use of bans alone to plastic bags may not yield to the expected results, and use of other alternatives way of managing other plastic waste is still very necessary.

However, from the study many consumers are now reusing plastic bags and containers when going to shopping as the result shows 50% of the respondents while 42.5 sometimes they reuse plastic bags and containers. This is one of the principles of circular economy whereby products can be reused as a way of reducing plastic waste. It is worthy to note that through the study, many consumers consider price as one of the key factors in determining the product to buy. This impacts the products market demand to the consumers for products made in sustainable way or through circular economic principles such as recycling, repairing recovering and redesigning.

The study shows many consumers are aware of the plastic waste management policies and laws. However, their understanding level might be of subject of interest for further study. The level of awareness would be attributed to the 2017 ban of plastic bags which was publicised through the media.

From the study result analysis many consumers think that circular economy is the effective way of dealing with plastic waste. This research supports the literature that circular economic principles support sustainable way of managing resources. However, the understanding of circular economic principles to plastic the consumers in plastic waste management are an area which might need further study.

5.2 Discussion on qualitative data

Results from qualitative data analysis leads the study to the following discussion on circular economic approaches applied in plastic waste management, legal and policy frameworks to plastic waste management, and consumer's behaviour and attitudes in the Kenyan urban centres.

From data analysis, the literature as presented, and observation made shows plastic waste management is a major challenge within Kenya and especially Kenyan urban areas. As presented in data analysis, there is no waste separation from the point of origin and plastic waste ends up in form of litter in water pathways or dumped together with other solid waste in dumping sites as presented in picture

1 and 2. The study reinforces the literature from other studies for instance (Omondi and Asari 2021), (Horvath et al, 2018), (Oguge 2019) that Kenya still doesn't have a clear plastic waste management structure within its' urban areas, despite several measures being taken by the national government and local government such as use of bans to plastic bags, incentives through tax reduction in circular economy industry, and the sustainable waste management policy.

5.2.1 Circular economic approaches and plastic waste management in Kenyan urban centres

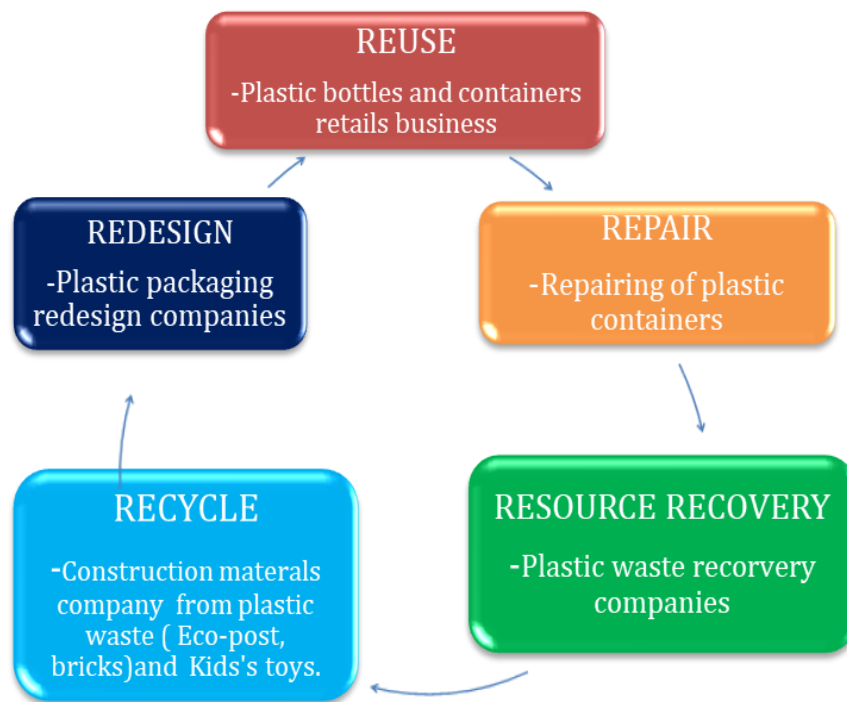
There are several measures Kenyan national government has taken towards managing plastic waste in collaboration with the local government and private sector in Kenya and through regulations such as bans. Plastic waste management in Kenya is a shared responsibility from the national government through the Kenyan constitution Kenyan Constitution Article 69(2), (2010) and county government under the devolved functions of county government as presented in the data analysis and literature. Kenyan has taken regulatory measures in plastic management through several legislations and policies which aim at limiting the amount of plastic waste pollution, solid waste management and increasing recycling infrastructure.

Several circular economic approaches are used in managing plastic waste in urban areas through private companies and initiatives as presented in data analysis. However, many of these circular economic approaches are undocumented. "Jua kali" sector plays a key role in development of circular economic initiatives in plastic waste management in Kenya as documented in the assessment report by Netherlands Enterprise Agency (2021).

The 5Rs (reuse, repair, resource recovery, recycle, redesign) of circular economic principles are applied in the plastic waste management through several private companies and initiatives within the Kenyan urban area as presented in data analysis. And this can be summarized in Figure 14 which shows a diagram analysis on different circular economic business models and products produced from plastic waste in Kenyan urban centers.

In figure 14, different circular economic business models used by companies in Kenya urban areas to manage plastic waste. It also shows end products from the respective circular economic business models.

FIGURE14. Different business circular economic models of companies and the respective products from plastic waste in Kenyan urban areas.



5.2.2 Policy and legal frameworks in plastic waste management

It is clear from data analysis that plastic waste management in Kenyan urban areas is regulated through several regulations and policies as presented in data analysis. Based on the data analysis, plastic waste management has no national legal framework in specific but rather fragmented legislations and policies which address different areas of plastic waste. Some of these legislations includes:

- Secondary packaging plastic bags ban in 2017 which prohibits manufacturing, importing, distribution, and the use of single use plastic bags (NEMA 2017)

- Plastic bag control and management regulation (2018), which requires those engaged in plastic circulation industry to get permit as control measure.
- Ban of single use plastics (2020) in some specific areas such as national parks, beaches, forest, world heritage sites and conservation areas.
- National Sustainable Waste Management Act (2021) which lays a framework for sustainable waste management laws and policies in Kenya.
- Extended Producer Responsibilities Act (2022) which requires companies to adopt and implement proper practises in packing plastic wastes.
- Nairobi City Council Solid Waste Management Act (2015) which provides Nairobi County framework for solid waste management. It also provides guidelines on the implementation of solid waste management plan for Nairobi city.

The fragmentation of plastic waste management policies and legislations in Kenya comes with other challenges such as lack of clear implementation mechanism as already highlighted for the plastic bags ban in the literature (UNCTAD 2021). There is a need to harmonize the various legislation which regulates plastic waste with clear legal framework and policies, and circular economy both at the national and county level. There are also gaps in policy and legislation on plastic waste separation with other solid waste.

Both the national and county level need clear legal and policy frameworks regarding sustainable plastic waste management for better and efficient implementation of the relevant laws and policies. It is important to note that plastic waste management falls within the solid waste management according to the current structure of waste management in Kenya.

Consumer's behaviour and attitude in Kenya urban areas

Consumer's attitude in plastic waste management in the Kenyan urban areas is associated poor waste separation and disposal practises as shown in picture 1,2 and 3. Many urban residents do not practise waste separation at their household level. This would be due to attributed to lack of waste separation policy and legal measure, and undeveloped waste collection systems.

However, based on other studies carried out on consumers' awareness about plastic bags, many Kenyans are aware of the impacts of plastic waste and the related policies and laws (Omondi and Asari 2021). The level of economic disparity and urbaneness affects consumer's level of awareness to plastic waste and best management practices. People living in urban areas in Kenya and with high income levels are likely to be conscious on how they dispose the plastic waste compared to those in low-income urban areas.

There is a need for better educational awareness on best plastic waste management practices in areas with low income earning urban areas. There are no policies on plastic waste separation from household waste.

5.3 Conclusion

In summary this study finds out that, there are several circular economic based model business initiatives going on in the Kenyan urban centres dealing with plastic waste management. From the study the 5Rs of circular economy identified in dealing with plastic waste includes reuse, repair, recovery, redesign, recycle of plastic waste in the urban areas. However, there is no structured plastic waste management since the country and county governments have undeveloped solid waste management systems. Many of these initiatives are private companies, personal initiatives, or community-based organisations who are using circular economic approaches to manage plastic pollution. The scale of this initiative is still low since 15% of packing plastic in Kenya ends to landfilling, 18% recycled and 67% is disposed in open dumping sites (UNCTAD 2021). There are still many opportunities for circular economy approaches such as recycling, reusing, redesigning and other innovative sustainable plastic waste management in the Kenyan urban areas.

Although Kenya has taken several legal and policy measures in managing plastic waste, the country lacks a legal framework for specifically for plastic waste man-

agement. The measures taken by the Kenyan National government are by banning plastic bags and single use plastics in some specific areas, establishing laws on solid waste management and extended producer responsibility for packaging industry. These fragmentation of laws and policies creates confuse and challenge of implementation mechanisms. In addition, there is need to have clear policies and laws on plastic waste separation at the household level. National and county government needs to working coordination since plastic waste is a shared responsibility between the national government and county governments.

And lastly, consumers have a shared responsibility to change their environmental plastic littering culture to positive plastic waste management practises. Although many urban consumers are aware of the environmental and health impacts of plastic waste, they are yet to adopt best practices such as plastic waste separation. Since the bans, some of them are now reusing plastic bags and containers. More education awareness can help to better understand the laws and policies which aim at sustainable plastic waste management. Education awareness on circular economy approaches to plastic waste management can help to reduce plastic waste and environmental pollution in urban areas. Alternative adoption of ecofriendly products to consumers can be encouraged through use of incentives.

5.4 Recommendations

From the study, the following recommendations can help in future for better management of plastic waste in a sustainable way through circular economy:

1. Enactment of legal and policy framework to deal with sustainable plastic waste management in Kenya. The legal framework can help to harmonise various fragmented laws dealing with plastic waste, and this will ensure better implementation mechanisms. The framework can establish a structured way of dealing with all types of plastic waste sustainably.
2. Support of circular economy through national and county legislation on circular economy laws and policies in plastic waste management. Plastic waste management is a shared responsibility between the national government and county governments. Therefore, both levels of governance should be clearly involved.

3. Addressing the challenges facing circular economy businesses through economic and financial support, tax reductions, and other incentives to attract more investments in plastic waste.
4. Educational awareness to the consumers on best plastic waste management practises such as plastic waste separation, avoid illegal dumping of plastic waste, and even knowledge to make better market choices and preferences on ecofriendly products.
5. Government to adopt other instruments of management in addition to legal and policy measures in managing plastic waste. The use of market-based instruments can provide incentives to the consumers, thus aiding in change of plastic waste littering. An example of market-based instrument is use of reverse vending machines which has monetary incentives to return bottles and other plastics for recycling.

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APPENDICES

Appendix 1. Questionnaire

Circular Economy Approaches:

1 Are you aware of circular economy approach for managing plastic waste in Kenyan urban centers?

- a) Yes
- b) No

2 Have you personally participated in or benefited from any circular economy initiatives related to plastic waste?

- a) Yes
- b) No

3 Do you believe circular economy practices can effectively reduce plastic waste and promote sustainability?

- a) Strongly Agree
- b) Agree
- c) Disagree
- d) Strongly Disagree

4 Have you noticed an increase in the availability of eco-friendly and recycled products in your area because of circular economy efforts?

- a) Yes, significantly
- b) Yes, slightly
- c) No change
- d) Not sure

5 Are you willing to support businesses that embrace circular economy principles, even if their products may be slightly more expensive?

- a) Yes, definitely
- b) Yes, if the price difference is reasonable
- c) No, I prioritize cost
- d) Not sure

Legal and Policy Framework

1. Are you aware of the Plastic Bags (Management and Handling) Regulations in Kenya and their impact on plastic waste?
 - a) Yes
 - b) No
2. Have you observed a decrease in the use of plastic bags since the introduction of these regulations?
 - a) Yes
 - b) No
 - c) Not sure
3. Do you think that the Plastic Waste Regulations have influenced the disposal and recycling of plastics in Kenya?
 - a) Yes
 - b) No
 - c) Not sure
4. Are there any specific areas where you believe the government's legal framework for plastic waste management can be improved?
 - a) Yes
 - b) No
5. Have you seen businesses adopting more sustainable practices due to regulatory changes?
 - a) Yes
 - b) No
 - c) Not sure

Consumer Behavior and Attitudes:

1. How frequently do you use single-use plastic products in your daily life?
 - a) Frequently
 - b) Occasionally
 - c) Rarely
 - d) Never
2. Are you aware of the environmental impact of single-use plastics on the ecosystem and human health?
 - a) Very Aware
 - b) Moderately Aware

c) Slightly Aware

d) Not Aware

3. Have you actively reduced your use of single-use plastics in the past year?

a) Yes, significantly

b) Yes, slightly

c) No change

d) No, I have increased usage

4. What factors influence your choice to use or avoid single-use plastics?

a) Convenience

b) Cost

c) Environmental concerns

d) Other (please specify)

5. Do you carry reusable bags or containers when shopping to reduce plastic waste?

a) Always

b) Sometimes

c) Rarely

d) Never

6. Do you believe that plastic waste management is a shared responsibility among consumers, businesses, and the government?

a) Yes

b) No

7. Are you willing to pay a premium for products that use eco-friendly or recycled packaging materials?

a) Yes

b) No

8. What types of incentives or rewards would motivate you to recycle more and reduce plastic waste?

a) Discounts on eco-friendly products

b) Cash rewards

c) Access to recycling facilities

d) Other (please specify)

9. Are you familiar with government policies and regulations related to plastic waste management in Kenya?

a) Yes

b) No

10. Do you think that plastic waste can be effectively reduced through a circular economy approach, where materials are recycled and reused in a closed loop?

a) Strongly Disagree

b) Disagree

c) Agree

d) Strongly Agree.