AALBORG UNIVERSITY
STUDENT REPORT

An exploration of the Returnable Glass Bottles process in Nigeria and its applicability to plastic bottles

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Synopsis:

The informal collection and reuse of resources in Nigeria has been present in the landscape for several years. The Returnable Glass Bottle (RGB) process used by beverage companies has been in existence in Nigeria for many decades. The RGB process is practiced as a business model, however, it entails many aspects of circular economy. With plastic pollution on the rise as a global issue, an exploration of this circular business model is performed to discover if this idea can be transferred to plastic bottles.

Feyisayo Ayomide Osifuwa

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By signing this document, each member of the group confirms participation on equal terms in the process of writing the project. Thus, each member of the group is responsible for all contents in the project.

Summary

This project explores the Returnable Glass Bottle process that is used as a business model in many beverage companies in Nigeria. The process is a circular model that ensures that utilises glass bottles as company assets that are returned to the business for reuse. This approach has been used for decades and is known and utilised by Nigerian consumers.

Globally, plastic waste and plastic bottles pose a threat to society as there is an increase in the amount of plastic found polluting the biosphere. Circular economy is a narrative currently being pushed as a model for waste management. The goal of circular economy is to encourage waste to be viewed and used as a resource, ensuring that less waste is found in landfills and a closed loop is formed to keep resources in constant use.

The Returnable Glass Bottle process is explored as there is a desire to investigate current circular solutions that do not need to be adjusted for the social setting. As this scheme already exist, the hope is that there will not be a need to localise the solution as factors to be considered for implementation will focus on the material variation and not social differences. On many occasions where foreign solutions are implored, the technology most suitable already exists in the environment.

By exploring the circular glass reuse practise, the elements necessary for its success are explore how the technology works and to see what technique, knowledge, organisation and product the process entails and to delve into the transferability of these aspects to other products. The aim of this exploration is to consider how a similar model can be explored for plastic bottles. The result is a presentation of factors that need to be addressed to introduce an alternative model for the reuse of plastic bottles to serve as a possible solution for the overall global issue of plastic waste pollution as it manifests in Nigeria.

Preface

This research project examines waste management and circular practices in Nigeria. The project emphasis is on the reuse of glass beverage bottles and the potential of implementing a similar scheme with plastic bottles is explored. This project satisfies the requirements for the fourth semester of the MScEng in Environmental Management and Sustainability Science at Aalborg University.

The author would like to acknowledge Søren Lokke the project supervisor for his guidance and suggestions. The author would also like to thank all parties involved in providing the information necessary for completing this work. As the author did not conduct this research in Nigeria, a special thank is given to all those who provided pictures to serve as photographic evidence and provide a clearer picture of the status quo.

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Introduction

Circular economy is a principal idea that centres around keeping products in a loop of continuous reuse and prevents or delays materials from being disposed of or ending up in landfills. Many emerging markets informally practise circular economy ideals by reusing, recycling, and repairing items. The concept of circular economy as a way of repurposing products is conducted in various forms in Nigeria. However, many of these prevalent practices are not integrated or incorporated into formal solid waste management schemes.

A distinct example of a circular practice that exists in Nigeria is the reuse of plastic and glass beverage bottles. Initial use and subsequent reuse of plastic and glass bottles range from repurposing of bottles by individuals and small-scale entrepreneurs to the requisite collection of glass bottles by leading beverage companies for reuse. Several countries have formalised and thriving bottle reuse and deposit programs accepted by society and incorporated into everyday practice. Although all mentioned methods of bottle reuse are fascinating, the focus of this thesis is to explore the direct reuse of glass bottles by beverage companies in Nigeria.

An investigation will be made to analyse the current state of recycling and reuse of glass bottles in Nigeria's beverage industry. This investigation centres on companies' motivation for reusing glass beverage bottles and analyses how this circular scheme functions. As plastic waste poses an issue, the goal is to examine the transferrable potential of this glass reuse scheme and, assess whether it can be expanded to plastic bottles to serve as a possible solution for mitigating the negative effects posed by plastic waste to the biosphere.

This exploration begins with a review of the current formal, informal and, local waste handling and recycling practices in Nigeria. The conclusion of the study will be recommendations on the socio-technical concepts that need to be in place to aid the possible transferability of the glass beverage reuse scheme. The socio-technical concepts, along with the aspects of the technology will be explored to see how these strategies can best be utilised. This approach has intentionally been selected as it is a departure from solely implementing plug and play solutions that may not translate in the same manner or cultural context.

1.1 Circular Economy

The concept of a circular economy rethinks the current extractive industrial model. The goal is to move from the idea of taking, making, and disposing of resources to regenerating natural systems that keep products and materials in continuous use, ultimately eliminating waste from the products' design (Ellenmacarthurfoundation.org, 2020). The idea of a circular economy and the necessity of including this model in the design of products is to ensure that the result of production fares better in the general recovery of value. This can be attained by reusing products, reducing the use of materials or, by recycling, (to name a few options). The manufacturing of products must be done in a manner that allows for inherent value to be available for users and in the next phase of the product's life cycle.

To achieve this, companies need to better select materials, standardise components, design longer-lasting products, and simplify sorting at the product's end of life. It is important that systems enable the use of, and encourage circular economy by creating policies, providing finance, and ensuring that popular opinion veers in a direction that pushes these initiatives (Ellenmacarthurfoundation.org, 2020). The European Union (EU) has adopted an EU action plan for a circular economy and outside of Europe, the concept is slowly being integrated into local and national governments, driving development goals and investments (Kaza et al., 2018).

One can insinuate that informal recycling practises utilised in many nations and prevalent in developing and emerging economies have similar elements to practices that are encouraged by circular economy. Prior to the industrial revolution, waste was minimal as most products were repaired and reused. Materials were recycled and organic matter was returned to the soil (all of these being strategies/key components of circular systems and circular economy). During this period, most cities had limited resources, many people did not have disposable incomes, and household needs exceeded their means. Extensive informal recycling systems thrived in such an environment; however, the emergence of formal municipal waste collection system gradually displaced this system in the late 19th century (UN-Habitat, 2010).

Society has slowly shifted away from practices exemplified in the early 19th century and moved towards a throw-away society rooted in consumerism in which people purchase single-use products and are quick to dispose of materials. Circular economy practices share many similarities with earlier lifestyle patterns. The idea is to rethink the current approach and adjust business models, policies, and frameworks to include these principles.

Industrialisation has led to a rise in consumption in developing nations and emerging markets moving these societies towards throwaway culture and Nigeria is no exception. Due to limited purchasing power and availability of goods, there appears to be more reuse, repair, and recycling mimicking ideals from earlier century lifestyle patterns. The idea of a circular economy, although explored, has not yet been used as a framework or pushed as a narrative as it has in European Union directives.

1.2 Waste Hierarchy

Within circular economy, there is a preference to the order in which waste is processed. The waste hierarchy is a presentation of the most constructive approach to waste management and provides a scale of the most to least favourable options. According to the waste hierarchy,

the refusal of waste is the most desirable and effective method of reduction. Following refusal is reuse, recycling, recovery and finally, disposal.

Below is a schema of the current waste hierarchy presented by the European directive.

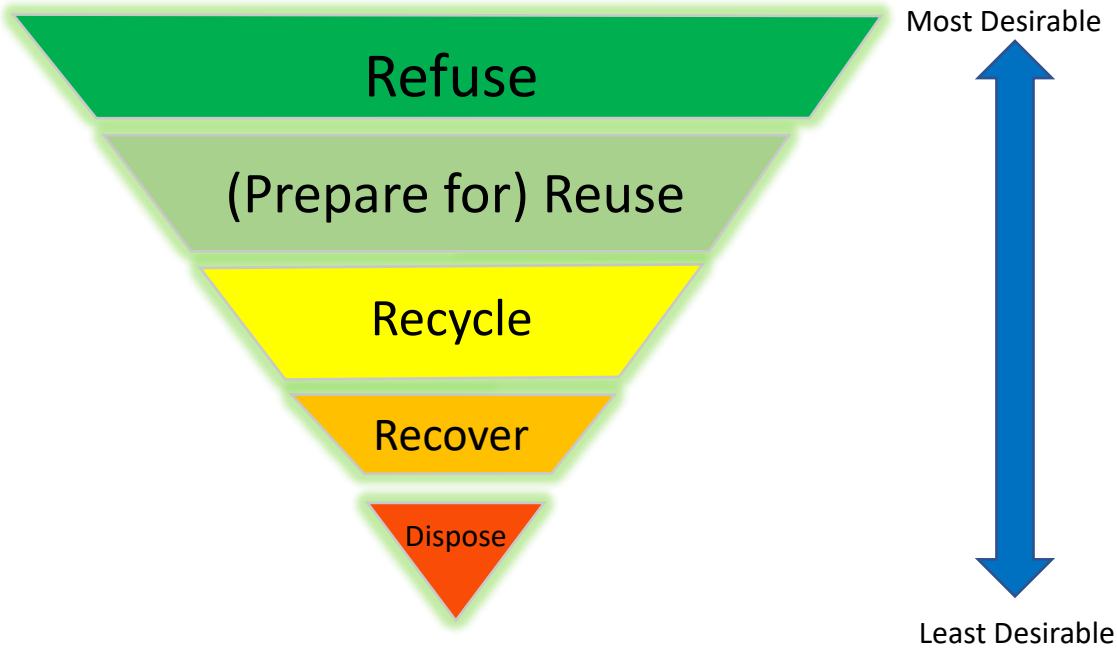

Figure 1: The waste hierarchy (Own Figure)
(Based on Directive 2008/98/EC on waste (Waste Framework Directive) - Environment - European Commission, n.d.)

An expanded view of the waste hierarchy is presented by Zero Waste Europe, a movement of communities that share a vision of eliminating waste in society (About - Zero Waste Europe, 2020). Their hierarchy differs from that of the European Union as it rethinks the way resources are used. This shifts from a mindset of waste management to resource management and helps to ensure that the overall degradation effect of waste is minimal, and resources are preserved in the economy for upcoming generations.

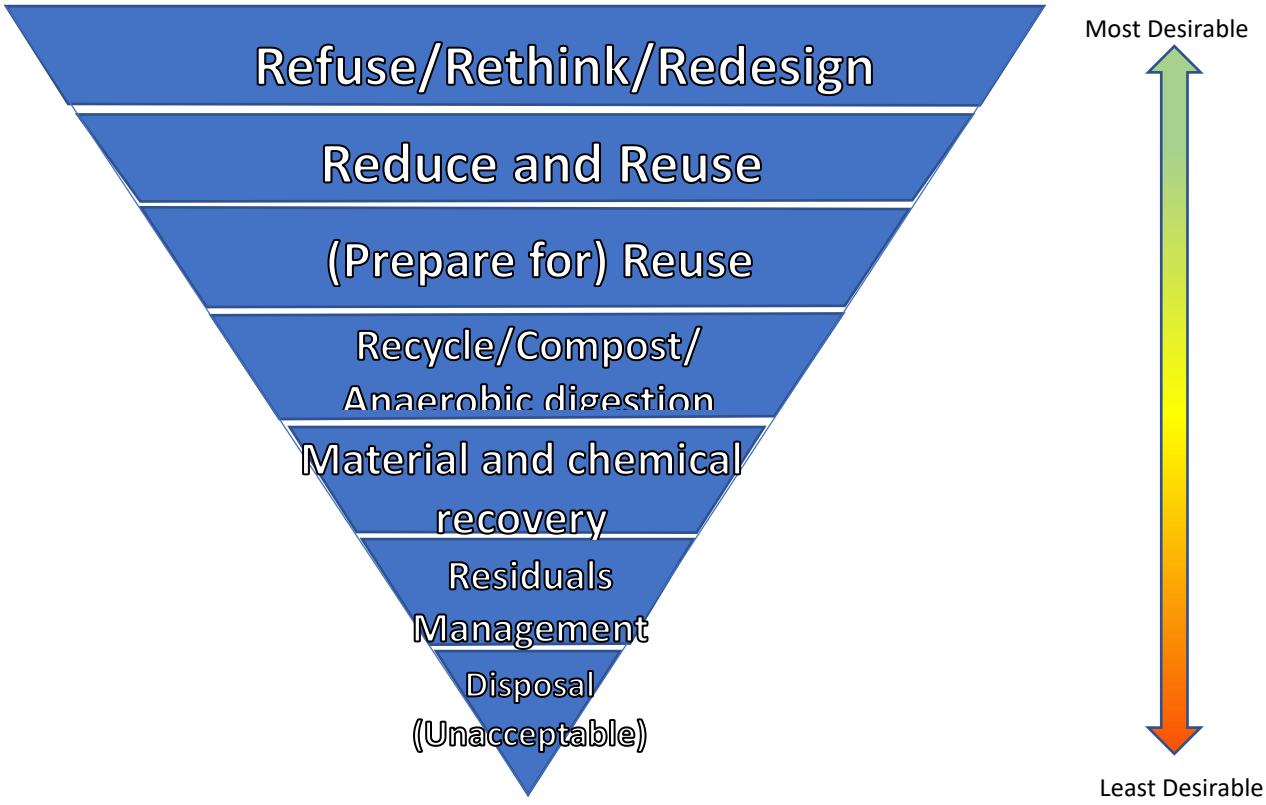

Figure 2: The Zero Waste Hierarchy as presented by Zero Waste Europe
(Own Figure based on: (Simon, 2019)).

The stages of the Zero waste hierarchy from most to least desirable are as follows:

Refuse, rethink, redesign - this stage explores the idea of prohibiting waste from being produced. The goal is to create waste-free designs and systems that reduce single-use items by providing alternative options. The idea is to refuse unnecessary materials and to redesign business models in a manner that reduces resource-use (Simon, 2019).

Reduce and reuse - a combination of 2 of the encouraged 3 Rs (reduce, reuse, and recycle), this level encourages the reduction of material use and an increase in the reuse of items. The goal is to prevent disposal and push items back into the economy. Along with prevention, the aim is to reduce toxicity and ecological footprint consumption by using items for the same purpose or by repurposing in ways that do not reduce their value (Simon, 2019).

Preparation for reuse - encourages cleaning, repair and refurbishing of items to extend their life cycle. The goal here is to reuse items without pre-processing (Simon, 2019).

Recycling, composting, anaerobic digestion - the 4th level and in an ideal cycle, the final level, this stage calls for transforming waste into high-quality secondary materials (Simon, 2019).

Material and chemical recovery - by prioritising the extraction of valuable materials from the discards of sorting processes and mixed waste, the zero-waste hierarchy is better aligned with the vision of a circular economy as it aims to retain materials and resources in the loop.

Residuals Management - this stage calls for biologically stabilising mixed waste before sending it to the landfill.

Unacceptable - this stage is for items that do not allow for material recovery, have a high environmental impact, and prevent the transition to zero waste. Examples of unacceptable waste management practises are open burning, littering, illegal dumping, and landfilling without prior stabilisation (Simon, 2019).

There has been a shift from the initial mantra of the 3Rs – reduce, reuse, recycle to the use of the waste hierarchy by the EU directive (Simon, 2013). Now, there is a presentation of a zero-waste hierarchy that is combined with the ideas of a circular economy. We can see that waste handling is ever evolving. This also shows the shift in the way waste is viewed and the transition to seeing waste as a resource, fulfilling the goal of achieving zero waste. All aspects of the waste hierarchy currently do exist in a Nigerian framework. However, it can be argued that the reuse and repair aspects are heavily leaned on as options while widespread recycling is making its way into the landscape. It is currently being introduced and implemented into government schemes and regulations.

1.3 Initial Curiosity

Before the formal introduction of waste hierarchies, and the desire to implement these principles into a structured approach, there has been evidence of repairing, reusing, and recycling of products and items on a large scale by businesses in Nigeria. The image below illustrates bottle reuse as women hawk groundnuts in repurposed plastic beverage bottles.

Figure 3: Women selling groundnuts in repurposed plastic beverage bottles (Kalu, n.d.)

Figure 4: Plastic Bottle repurposed as a tennis ball holder (Fawunmi, 2020)

In addition to the recognised trend of reuse, the authors of the UN-Habitat's Solid waste management in the world's cities also identify that the use and success of recycling schemes can be attested to that recycling occurring for two economic reasons.

- There is a market value for secondary materials
- There is a policy-driven activity that relates to avoiding the cost of disposal

(UN-Habitat, 2010:169).

Market value serves as an explanation for the collection and selling of items to be reused, repurposed, or recycled. The reuse of products in many of these scenarios are examples of circular economy practices. Although not necessarily the goal, these fulfil the idea of keeping products in a cyclical loop and not a linear system in which the destination is disposal.

The latter reason highlighted in the UN-Habitat's report justifies the rise of legislation and the introduction of Extended Producer Responsibility (EPR) plans. The policy drive serves to ensure that goods and products (including their packaging) are sustainably managed from production up until post-consumption. The Organisation for Economic Co-operation and Development, OECD defines EPR as a policy approach which gives producers a significant responsibility for the treatment or disposal of post-consumer products. The OECD is an international organisation that works with governments, policymakers, and citizens to build better lives by working together to create policies that foster prosperity, equality, well-being and opportunity for all (About the OECD - OECD, 2020). "By assigning such responsibility to organisations, this could provide incentives to prevent waste at the source, promote product design for the environment, and support the achievement of public recycling and materials management goals" (Extended producer responsibility - OECD, 2020). Holding producers accountable for the entire products' life cycle including post-consumer practice should lead to a reduction in environmental impact (Extended Producer Responsibility (EPR) Programme, 2020).

The implementation of EPR plans is occurring more often in the industry as the idea of a circular economy and circular practice becomes widespread and gains increasing popularity. Although legislation may not be the sole basis for the introduction of EPR practice, the move towards policy to reduce the effects of packaging disposal responsible for waste pollution ensures that producers are as involved in the end life of products as consumers are. This manifests in several ways and there are voluntary measures that private corporations are exploring to ensure that circular approaches are utilised.

In Nigeria, NESREA, the National Environmental Standards and Regulations Enforcement Agency oversees the EPR programme and the framework of action for collaboration between government and businesses to move towards achieving zero waste and reducing the impact of packaging. NESREA is responsible "for the protection and development of the environment biodiversity conservation and sustainable development of Nigeria's natural resources" (NESREA Official Website | About Us, 2020). Their vision is to ensure that the environment is cleaner and healthier for all Nigerians. NESREA's responsibility is enacted upon the organisation by the NESREA Act (NESREA Official Website | About Us, 2020). By putting the EPR programme into action, NESREA can hold producers responsible for the post-consumer life of packaging and encourage better take back, recycling, and disposal of product packaging.

Another example of an industry-driven response to waste and package handling is the establishment of the Food and Beverage Recycling Alliance (FBRA). Established in 2013 and started as a voluntary organisation, the FBRA was is composed of companies in Nigeria who have a shared concern for the environment and are committed to promoting sustainable solutions to post-consumer packaging and waste in the food and beverage sector (Food & Beverage Recycling Alliance, 2020). The FBRA currently consists of ten (10) organisations, many of which are classified as companies that produce fast-moving consumer goods (FMCGs). Now, the FBRA serves as a Producer Responsibility Organisation (PRO) in response to NESREA's categorisation strategy for their EPR programme.

By collaborating and creating this alliance, one of the FBRA's goals is to pioneer compliance with EPR programmes and create a culture in which post-consumer packaging is handled in an environmentally sustainable manner (Food & Beverage Recycling Alliance, 2020). Standards Organisation of Nigeria (SON) is working on a standard for Recyclable Polyethene Terephthalate (RPET). The objective is to respond to stakeholders request, reduce importation, increase opportunities for employment, and serve as a response to the Federal Ministry of Environment (FMEV) as a national policy for the life cycle of plastic is developed (Ihua-Maduenyi, 2019). The FBRA is currently focused on the recovery of plastic and the waste caused by it in the fast-moving consumer goods industry. The goal is to find more sustainable and universal packaging solutions that better aid waste handling and recycling practices. The focus on plastics is important as plastics are one of the major sources of waste pollution (FBRA, 2020).

The introduction and implementation of global and local programmes to combat waste management and resource reuse are clear. Responses have appeared in various manners ranging from government response to voluntary, and business approaches. It is important to holistically view issues and current on the ground solutions that can be adapted to societies

appropriately. The curiosity for this research stems from the desire to explore and gain an understanding of current waste handling solutions and what role these play or can play in effective resource management. This stems from the knowledge that not all methods of reuse are viewed as a means for solving resource management issues. In the next sections, existing practices and frameworks used for waste and resource management in Nigeria will be explored to serve as a basis for analysing the problem and exploring how local, existing practices can be adapted as a solution to current problems. In other words, discovering how to tailor and tweak local solutions to solve local problems.

2. Problem Analysis

2.1 Current waste flows

Globally, approximately 0.74 kilograms of waste per capita per day is produced. However, national waste generation rates fluctuate between 0.11 to 4.54 kilograms per capita per day. As countries' income levels rise, the number of recyclables in their waste streams increase. Studies have shown that an increase in income levels and urbanisation rates correlate with an increase in waste production (Kaza et al.,2018). According to Kaza et al. (2018), waste in lower-income countries has a 39% rate of collection. Waste in low-income countries is often managed by households and a substantial proportion of this waste, at times up to 93% is openly dumped. Other popular low-income methods for waste management include sending waste to landfills, burning, recycling, and on occasion, composting. Improvements in waste collection services can lead to a reduction in pollution and improve human health (Kaza et al.,2018).

Nigeria covers a landmass of approximately 923,768 sq. km with 853km of coastline (World Bank, 2016). The rate of waste generated is estimated at approximately 0.65-0.95 kg/capita/day resulting in approximately 42 million tonnes of waste generated yearly (Ike et al., 2018). The largest portion of Nigeria's waste consists of organic waste which makes up approximately 52% of the waste produced while 44% of waste consists of paper, metal, glass and, textiles (Ike et al., 2018). These results presented by Ike et al also correlate with the waste fractions that are most apparent in developing nations and presented in the UN-Habitat report.

To focus on a specific case in Nigeria, below is a snapshot of Lagos' waste management authority's (LAWMA) waste fractions. By using these waste composition numbers, one can see a breakdown of urban waste by fractions. Although these numbers vary from the waste characterisation of Nigeria, there is still a correlation to the waste numbers that are presented in developing markets with compost forming a sizeable portion of the waste.

The waste flows according to LAWMA are as follows:

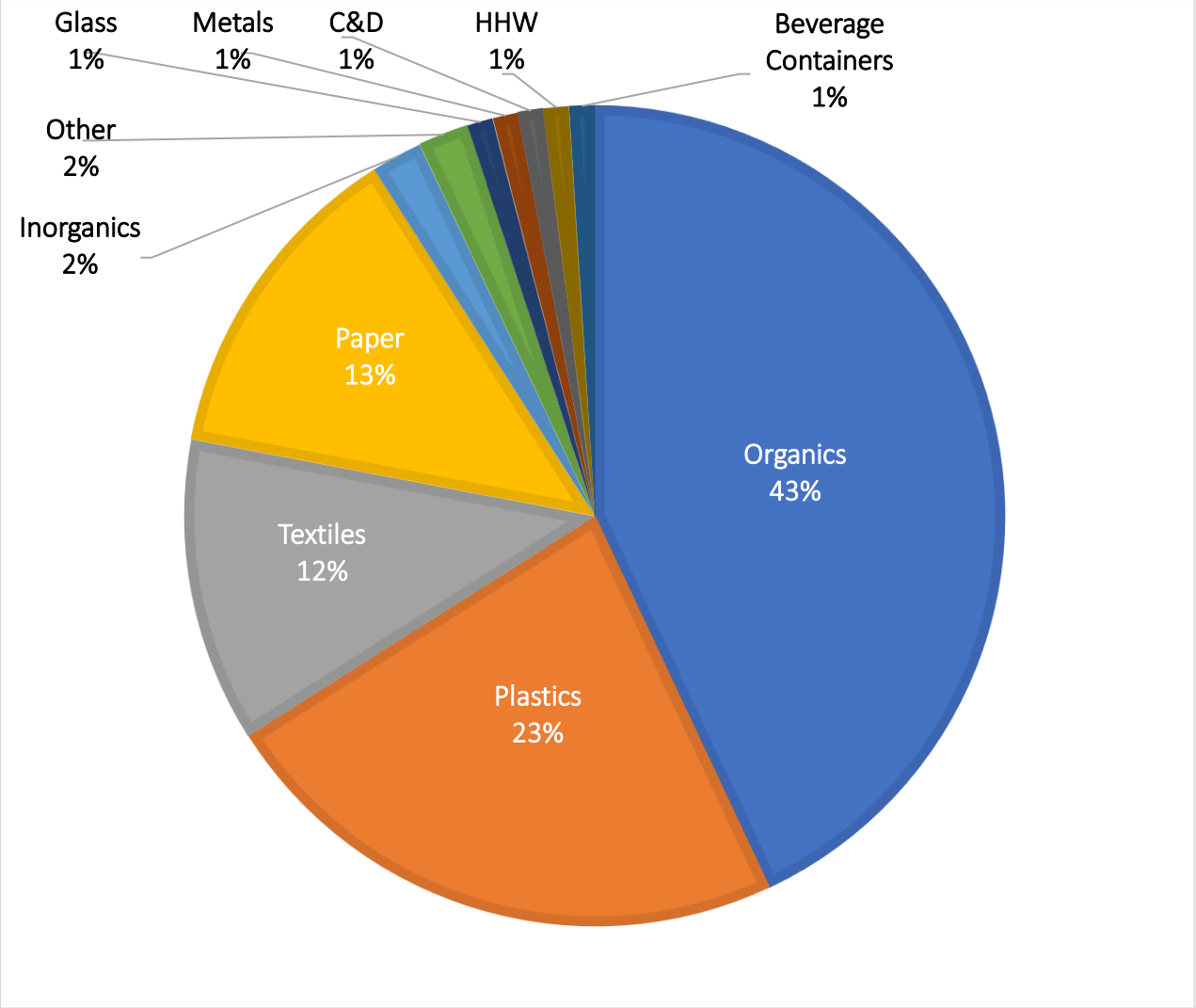

Figure 5: Pie chart of LAWMA's waste composition
(based on number provided by: LAWMA, 2020)

2.1.2 Plastic Waste

As shown in the LAWMA waste composition, plastic makes up a significant percentage of)waste. First produced in 1907, modern life is now unthinkable without plastic. The characteristics that make plastic useful - its durability, lightweight, and low cost are also the characteristics that make its disposal problematic. Global plastic production grew from 1.5 million tonnes (Mt) per annum in 1950 to 245 Mt in 2008 (European Commission). In 2018, the world's plastic production totalled around 359 million metric tons (Garside, 2019).

Due to the exponential growth of plastic packaging manufacturers in the market, the Nigerian plastics and packaging sector has gone from 50 plastics companies in the 1960s to approximately 3,000 companies in 2013 and has a production capacity of over 100,000 tons per year. The growing market for plastic products has driven this development. Due to its low cost, and versatility, plastic is increasingly replacing metal, glass, ceramic, and wood in products and is often used as packaging in the fast-moving consumer goods industry (Babayemi, Ogundiran, Weber and Osibanjo, 2018). The convenience, pricing and ease of use make plastic a problem in solid waste management (European Commission).

Nigeria has a large volume of imported plastic and polymers that should be accounted for as it has an important implication on marine litter, pollution, waste management and resource recovery. In 2010, approximately 275 Mt of plastic waste was generated in 192 coastal countries. 4.8 to 12.7 Mt entered the ocean and 0.25 to 1.00 Mt of that number came from Nigeria (Jambeck et al., 2015). Between 1996 and 2014, more than 23,400,000 tons of plastic has entered the Nigerian Technosphere and as of 2015, 6300 Mt of plastic waste was generated globally and only 9% of that is recycled, 12% is incinerated, and 79% is accumulated in landfills (Geyer, Jambeck and Law, 2017). Although plastic is fully recyclable, only a small fraction of plastic waste is currently recycled (European commission).

In Nigeria, less than 12% of plastic waste is recycled. Plastic bottles along with other household plastic waste usually end up at dumpsites as waste is not typically separated at the source of creation. This contributes greatly to environmental pollution. The results of the presence of plastic waste can cause harm to aquatic life and coastal and marine environments (European Commission). Once in the ocean, decades of photodegradation and mechanical abrasion creates small and fine particles of plastic called microplastics. Microplastics become ubiquitous and can reach even the most remote areas and these microplastics can sometimes have a higher presence in water than plankton. If ingested in large amounts, microplastics, and the chemical additives they contain, can contaminate marine fauna, and affect the other members of the food chain that follows plankton (European commission). Ocean plastics persist in the marine environment and can last for hundreds of years as it breaks down into microplastics in the Arctic sea ice (Babayemi, Ogundiran, Weber and Osibanjo, 2018).

By reducing plastic use and recycling, the amount that is sent to landfills can be significantly reduced. This can result in a reduction in the importation and manufacturing of plastic products resulting in saving energy, conserving fossil fuels, and increasing resource efficiency (Hopewell, Dvorak and Kosior, 2009). This can lead to a reduction in greenhouse gas emissions and dependency on non-renewable resources (Duru, Ikpeama and Ibekwe, 2019). Reuse of plastics should be encouraged as doing so serves as a means of resource efficiency and prevents landfilling of plastic waste which should be avoided. Saving natural resources and enhancing resource efficiency could drive an increase in sustainable plastic production. Optimally, like all waste, plastic products should be designed to be recyclable at a reasonable cost. As an alternative to better recycling rates, plastic goods should also be designed to maximise durability (European Commission).

Considering the risks this volume presents to human health and global and local environments, there is a need for sustainable management of this important waste and resource category (Babayemi, Ogundiran, Weber and Osibanjo, 2018). The potential to recover and recycle plastic is not realised as the amount of virgin plastic created surpasses the recovery rate of the product and leads to large disposal rates. The lack of material reuse has led to large quantities of waste in dumpsites and landfills and as marine litter.

Nigeria ranks 6th in global plastic marine litter release and the need for better plastic waste management is apparent. Strategies to mitigate plastic waste include reuse, recycling, the conversion of waste to energy, and the establishment of plastic control policy frameworks. These policies should address the waste hierarchy with an emphasis on waste reduction and

recycling (Babayemi, Ogundiran, Weber and Osibanjo, 2018). The presentation of the issues associated with plastic waste show that this material poses a modern-day issue and highlight the importance of actively searching for redemptive solutions.

2.2 Recycling and Material Reuse

There are primarily two ways in which waste can be viewed, that is; as a health risk or, as having inherent value or use (Sembiring and Nitivattananon, 2010). The belief that a waste product has inherent value or use involves viewing waste as having enough worth to be collected and reused or recycled. Recycling collection and practise that is coordinated by the government or business is commonly referred to as the formal recycling sector. Those who represent the informal sector or are referred to as informal waste handlers see waste as a resource and capitalise on furthering the life of products for various reasons. In this case, the desire to collect waste is not necessarily a desire to push an environmental agenda and more environmentally friendly options. Even though environmental benefits can be a positive outcome of waste collection, the motivation for the informal recycling /waste handling community is the capitalisation on waste as a resource. Instead of products being disposed of, a value is assigned to products and this increases the desire for them. Nigeria is skilled at identifying materials of value and recovering recyclables from the waste stream.

With the introduction of municipal recycling schemes in some emerging markets, when a city aims to modernise its solid waste system and 'introduce' recycling, the consultants or planners often do not consider the performance of these informal recycling sub-sectors. On many occasions, these are not even factored in and there is an assumption that not much in recycling is happening, or that what is already occurring is unimportant. In actuality, the informal sector may already be removing and recovering as much as 20 per cent of waste and this comes at no cost to the local authority. This positive environmental externality can be enjoyed at no (or minimal) cost to the municipality and the environmental gain is a by-product of the economic interests of informal recyclers (UN-Habitat, 2010).

2.2.1 Local/Informal Recycling waste management in Lagos

There is a growing trend in developing markets toward improving recycling and disposing of waste in controlled or sanitary landfills. However, in developing nations, recycling is typically unorganised, and the bulk of the work is done by the informal sector (Kaza et al., 2018). Informal recycling can happen in two ways. One is orchestrated by the informal sector and the other is by the personal collection and reuse of products. The reuse of waste items for businesses is prevalent as sellers and small entrepreneurs gather goods to use for selling their product. Glass bottles are recovered by scavengers and sold to market women who use these for peanuts or to package other goods for sale (Nzeadibe and Iwuoha, 2008). Reuse and repurposing of products can even be seen in homes as consumers look for various alternative uses for products before disposal (Fawehinmi, 2020). On a larger scale of informal recycling, there is an industry that solely serves to gather useful disposed products in large quantities.

To characterise the informal sector in this report, we will use this following definition , individuals or enterprises who are involved in private sector recycling and waste management activities that are not sponsored, financed, recognised, supported, organised, or

acknowledged by the formal solid waste authorities, or which operate in violation of or competition with formal authorities (Gunsilius, Chaturvedi and Scheinberg, 2011).

Many developing and transitional country cities still have an active informal sector and micro-enterprise recycling, reuse, and repair systems, which often achieve recycling and recovery rates comparable to those in the West (UN-Habitat, 2010). Informal waste collectors play an important role in providing cheap secondary raw materials and meeting the industry demands for recyclables. The major products recovered during this process include plastics, ferrous and non-ferrous metals, bottles, paper, and rubber material. The quantity and quality of waste products recovered are dependent on market availability, as waste pickers only pick products that have market outlets (Oguntoyinbo, 2012).

Informal recycling is generally carried out by marginalised social groups. Individuals in these groups tend to scavenge for goods with potential value or pick waste for an income and as a means of survival. Recycling in Nigeria is primarily carried out in urban areas and achieved by the informal sector. It is comprised of many actors, including scavengers who try to make a living through scouting for valuable materials like paper, plastic, glass, metal, e-waste etc. This process has helped in the reduction of the volume of waste disposed of (Ike et al.,2018). Informal waste collectors act as environmental agents in resource recovery and distribution. This unrecognised practise consists of manually sorting through open dumps, street bins, waste collector carts and, mixed waste for recyclables. Due to the unsafe methods and unwanted waste dumping involved in informal recycling, this practice is illegal and controversial in many Nigerian cities (Oguntoyinbo,2012).

In Lagos, informal recycling and waste handling are achieved by various groups of scavengers and collectors. Onígòs, (Yorùbá for bottle owner) collect cans and bottles. Traditionally, onígòs were found on the streets buying and collecting bottles and cans from households (Nzeadibe and Iwuoha, 2008; Idowu-Adegoke, 2020). Barro boys or Kólẹ̀ kólẹ̀s (Yorùbá for waste collectors) are the local cart pushers who work to collect waste from the community and were formerly relied on in large portions for waste management as households pay these individuals for collecting their waste. Kólẹ̀ kólẹ̀s and Barro boys are also popular means for waste management as there are an estimated 5000+ collectors who at one point made up more than 70 per cent of waste disposal in some parts of Lagos (Simelane and Mohee, 2015). Although many still are involved in the practice, it is now illegal for Kólẹ̀ kólẹ̀s and Barro boys to operate in Lagos.

Figure 6: Kólẹ kólẹ collecting waste in Lagos (Fawunmi, 2020)

Informal recycling, when properly supported and organised can create employment, improve local industrial competitiveness, reduce poverty, and reduce municipal spending on solid waste management and social services (Medina 2007). Incomes of waste pickers' can be increased by governments and corporations by creating sanctions, ensuring fair prices from aggregators, directly offering waste pickers a fair and consistent wage at deposit centres or helping waste picker cooperatives to establish contracts with large buyers of recyclables or companies. By formally recognising informal workers, these individuals can attain job stability, be acknowledged for their work, and be recognised in formal economy settings such as tax schemes leading to them having an overall impact on the economy.

As the informal sector serves as the main source for reuse and recycling, there is an argument and research has been done on ways that the informal sector can be encouraged, or suggestions on how to best continue with these practices. Investigating this niche shows that what a lot of low and middle-income cities lack in this realm is organisation. In the case of the informal sector what appears to be missing is "a clear and functioning institutional framework, a sustainable financial system, and a clear process for pushing the modernisation agenda and improving the system's performance. If there is no umbrella framework, the mixture remains a cluster of separate parts that do not function well together – or at all" (UN-Habitat, 2010:23). In LAWMAs efforts to integrate the informal sector, figuring out a structure that matches the current mode of operation in the sector is a constant challenge faced by the organisation. One example of this is the inability to provide daily funding or payment to individuals in the sector (LAWMA, 2020).

National regulations or guidelines can lead to the systematic consideration of waste pickers and recognition could lead to many benefits for the government and local municipalities. Investments and formalising informal waste programmes are an option that could lead to a reduction in municipal waste spending and result in improved waste collection and recycling.

There is a social stigma often associated with waste picking but political buy-in could allow for social inclusion in the solid waste sector. Other factors that limit the integration of informal waste collectors into the formal waste collection management system in Nigeria include the unhygienic method of operation; repressive public policy and negative public perception; lack of organisation and low quantity and quality of recyclables (Oguntoyinbo, 2012).

2.2.2 Formal Sector Recycling in Lagos

Recycling in the formal sector is done in various ways and is carried out by organisations that collect recyclables, separate, process, and sell them (usually glass, plastic, metal, paper and cardboard) to companies that utilize these products. Based on the definition of the informal sector used, one can conclude that the presented enterprises' form Lagos' formal sector. The enterprises and business mentioned are recognised by the government and even contracted by LAWMA as Private Sector Participants (PSPs).

WeCyclers is a social enterprise based in Lagos that uses incentives to encourage subscribers to collect recyclables. As a social enterprise, their work is done for profit and to serve as the solution to societal issues of insufficient waste management and poverty (WeCylers, 2020). WeCyclers offers two forms of service.

One structure involves partnering with corporations to accept and cart waste from offices to recycling headquarters. At their headquarters, recycling is separated and then sold to the appropriate parties and off-takers who purchase these recyclables for use. The social enterprise collects the following fractions of waste, plastic, paper, cans, and glass.

The second form of recycling by WeCyclers is done by partnering with citizens and the informal sector. In exchange for items and materials, the social enterprise offers money for sorted recyclables. Citizens are educated about this scheme through sensitisations where the enterprise goes into communities and explains the importance of proper waste management while also shedding light onto why they do their work and how it is done. All subscribers (those who sell recyclables to the enterprise) also have the option to have their recyclables collected (there is a smaller incentive as a collection fee is factored into the selling price). As oppose to collection, subscribers can sell their recyclables by bringing them to the headquarters (WeCylers, 2020). This model is also used in many other businesses and enterprises. Although there may be variations to the process, the idea is that waste is collected by individuals, it is sorted and exchanged for a pre-determined value. WeCyclers and similar companies and enterprises process and prepare these goods to be sold. These are then delivered to or collected to larger offtakers or companies that utilise the products for their business.

Figure 7: Sorting of plastic bottles at WeCyclers facility (Fawunmi, 2020).

Another formal collection model for collecting recycling used in the formal sector is very similar to the above, however, no subscribers are involved. Instead, recyclables are purchased from sellers (some in the informal sector) or collected from events halls, eateries, and recreation centres (or other establishments) in large quantity. Recyclables are cleaned and prepared for sale to aggregators and offtaker partners. Offtakers have agreements with recycling companies and once prepared for sale, these materials are sold in bulk and utilised for other purposes (Idowu-Adegoke, 2020).

2.2.3 Lagos Waste Management Authority (LAWMA)

In the 1970s, the oil boom in Nigeria led to industrialisation and urbanisation in Lagos. This urbanisation increased the volumes of waste created and the Lagos council was unable to properly address this. As a response to this, Lagos waste management authority (LAWMA) was formed, and it became the first waste management scheme in west Africa (Who we are – Lagos Waste Management Authority: LAWMA, n.d.). LAWMA is overseen by the states' ministry of environment and is the government body in charge of waste management.

Lagos' population of approximately 20 million[1] makes it Nigeria's and Africa's most populated city and LAWMA is responsible for ensuring that the 0.565 kg of waste created per capita per day in the state is handled correctly. (LAWMA, 2020).

LAWMA's blue box initiative

In 2019, LAWMA introduced the blue box initiative and is currently trialling the initiative in specific areas. The blue box program is a single stream collection program and it provides residents with colour coded collection bags for recyclables. Collection is included in the per household land use fee and separated by local governments and local community

[1]As of May 2020, Lagos' population ranges from 14 – 21 million people (Lagos, Nigeria Population (2020) – Population Stat, 2020; Karuga, 2019).
LAWMA utilises 20 million as their figure for waste management. 20 million was the figure expressed in 2 interviews (Idowu-Adegoke, 2020) and (LAWMA, 2020).

development areas. Pick up aligns with the Private sector participants (PSP) model used for waste collection. In this method, formal sector recycling collectors are assigned to collecting recyclables through the blue box initiative from local government areas (LGAs) and Local Development areas (LCDAs). (LAWMA, 2020; The Blue Box Program– Lagos Waste Management Authority: LAWMA, n.d.)

The goal and benefits of the blue box program are to:

- Create green jobs and strengthen the sector.
- Reorient scavengers as resource managers as there will be a zero-tolerance for scavenging by June 2021.
- Capture 50% of recyclables.
- Reduce the state's carbon footprint and encourage zero waste generation.
- Domestically source materials and increase economic security.

(The blue box program – Lagos Waste Management Authority: LAWMA, n.d.)

LAWMA has seen how the introduction of the blue box initiative has directly increased opportunities for employment. The initiative has also identified and created a wave of individuals who are willing to collect recyclables, or who have found a use for these materials. Many have seen the potential that these resources can be offer and are taking advantage of this structure for their businesses. The introduction of the blue box initiative also gives leverage to people to work in and receive recognition for their work in the reuse/recycling space (LAWMA, 2020).

2.4 Formal and informal sector Interlink

Involving the existing informal sector (or incorporating informal practices) and scaling these up and refining what is already being done can lead to an improvement in recycling performance. By examining their development and encouraging a change in the attitude of citizens and governments towards the informal recycling sector (and these practises) , they can be seen as being contributors as opposed to being viewed as nuisances. Although there has been an introduction to initiatives, the informal sector is the only form of public recycling that is currently fully active in Nigeria (Simelane and Mohee, 2015).

Handlers focus on products or waste that may have value to processors and buyers. By collecting materials and selling them to processors who clean and aggregate materials to distribute to industry, waste pickers play an important role in the recycling value chain (Kaza et al., 2018). Informal players in the recycling sector in Nigeria are not funded by the government and although waste management authorities are aware of their presence, these actors and their waste collection volumes are undocumented (LAWMA, 2020). Ultimately, there is an opportunity for cities to build on these existing recycling systems by maximising the use of waste as a resource, protecting and developing people's livelihoods, and reducing the cost of managing residual waste (UN-Habitat, 2010).

Formal private sector recyclers serve as intermediaries between the formal and informal sector. To gather materials and recyclables that are sold to aggregators or offtakers, the private sector recyclers and social enterprises interviewed leverage heavily on partnerships with

informal recyclers. One interviewee referred to the informal sector as the fuel behind the machine and expressed the need to formally recognise this sector as a lot of work is done by them (Idowu-Adegoke., 2020).

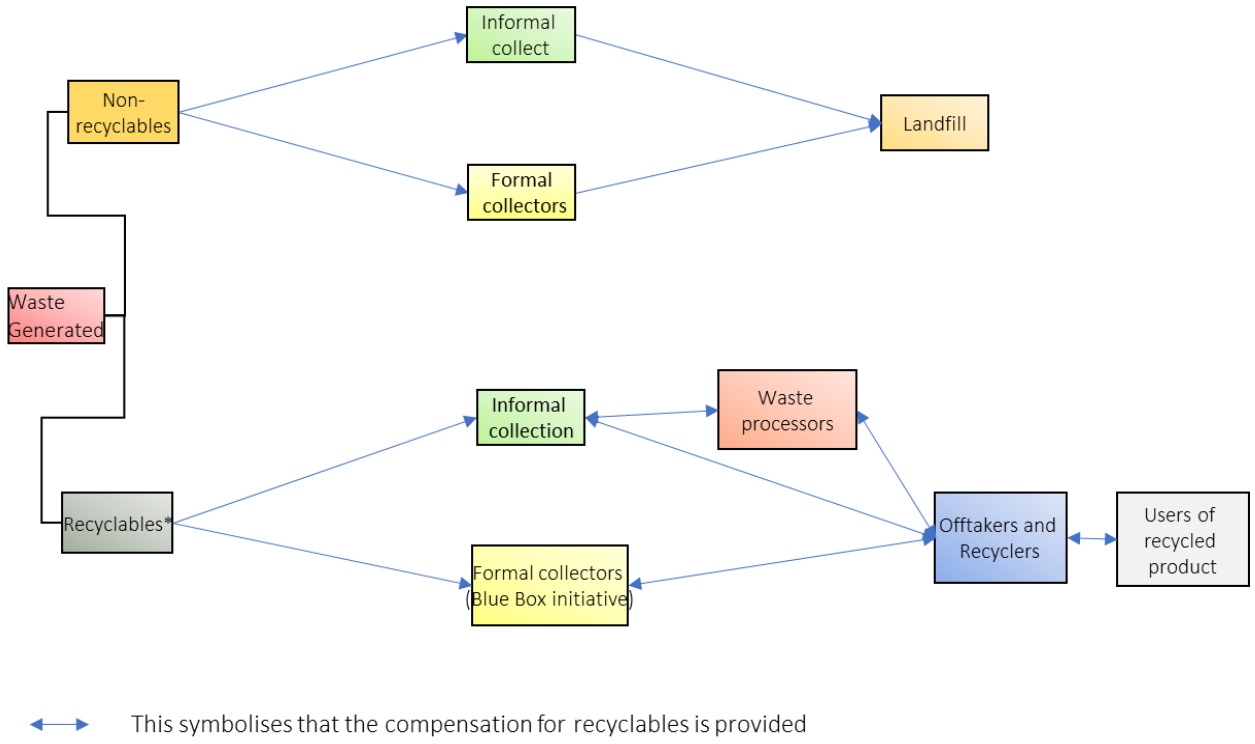

Figure 8: Visual representation of waste flows (own figure)

Although still in existence, the informal sector is no longer as predominant on the streets as these practices have been banned and there are moves to have zero tolerance for and ban scavengers as investigations are being made on how to proper integrate them into the system. One of the major challenges being faced is how to accommodate or compensate for the norm of a daily income that this sector is often used to (LAWMA, 2020). Some social enterprises have accommodated this challenge by serving as a savings account for their subscribers and providing payments on a scheduled time frame (WeCyclers, 2020).

In partnership with LAWMA, many private recycling companies work as Private sector participants (PSPs) and serve their allocated Local Government areas (LGAs) and Local Council Development Areas (LCDAs) as they collect recyclables on behalf of LAWMA. They then use these for their businesses and can sell these products to offtakers. This serves twofold benefit as it is an advantage for businesses and waste management authorities. It tackles the environmental, social, and health issues presented by improper waste management and has a trickledown effect as PSPs serve as intermediaries ensuring that the informal sector is connected to the system as actors in waste management. The scheme run by private recycling collectors allows for informal collectors to have a guaranteed outlet, and in turn receive payment. It also encourages a more structured approach to collection, distribution, and compensation for work. Literature emphasises the lack of and need for integrating the informal sector, this is currently addressed and there are several plans by LAWMA to find solutions to continue to integrate the informal sector into waste management.

3. Problem Formulation

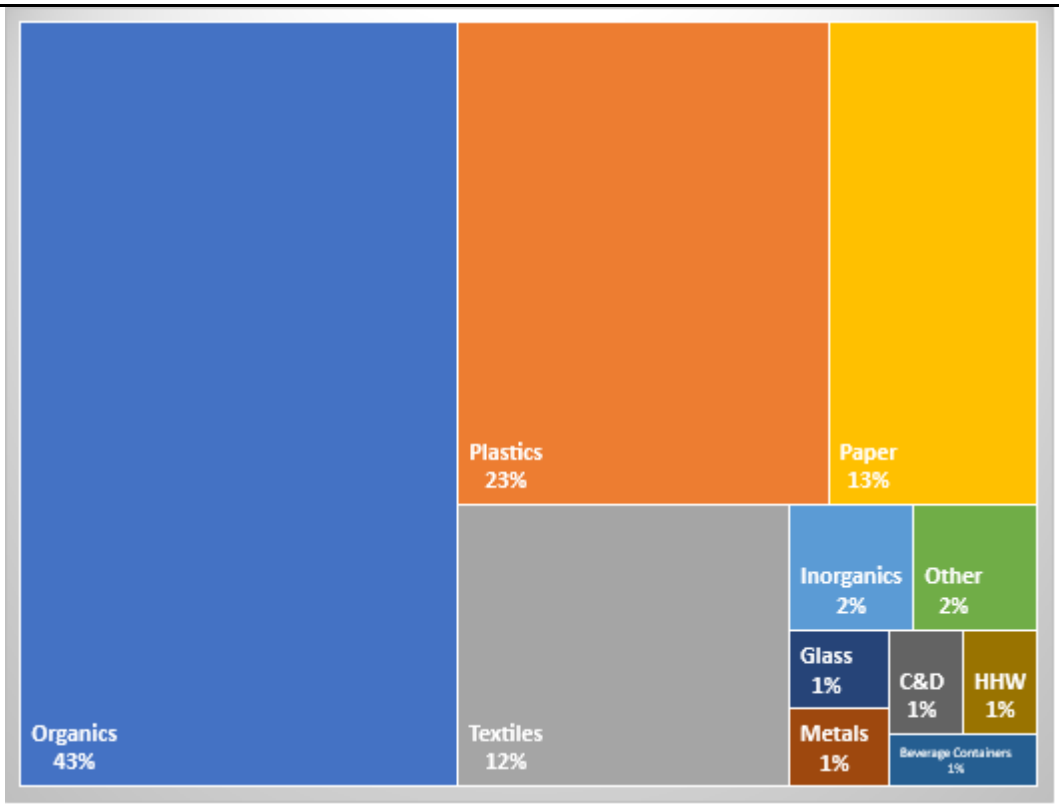

Figure 9:Tree Diagram with LAWMA waste composition (based on numbers provided by: LAWMA, 2020)

In this breakdown of waste formerly presented as a pie chart, one can see that following the organic (compostable) waste is plastic. Plastic makes up 23% of the overall waste found in Lagos. Although waste composition varies by location and with the season, short product life and minimal reuse provides an explanation for the large percentage of plastic waste found in the waste composition (Duru, Ikpeama and Ibekwe, 2019).

Figure 10: Plastic waste in Lagos gutters and waterways (L-own figure; R- Fawunmi, 2020)

It is approximated that one million plastic bottles are purchased every minute (Laville and Taylor, 2020). As pictured above, large amounts of plastic (including plastic bottles) make their way into drainages and waterways, especially in populated metropolitan cities where they become crammed in drainage channels. This can cause flooding when it rains and hinders the free flow of water. In addition to the havoc caused by flooding, they also have the potential to cause water-borne diseases such as cholera, typhoid, and dysentery (Oyebade and Olanrewaju, 2019). Plastic is also burnt along with other waste and this can result in smog and poor air quality. The consequences of burning waste (and plastics) is not known and many continue to participate in this practice, unaware that by-products of plastic combustion are airborne particulate emission (soot) and solid residue ash (Oyebade and Olanrewaju, 2019). Homing in on the effects of this material in Nigeria proves that plastic pollution is an issue and there is need for a solution that ensures better waste management and encourages the reuse and recycling of plastics.

3.1 Justification for further work

Oyebade and Olanrenwaju (2019) suggest that to better handle plastic waste, research and development should be done on alternative materials and economic incentives should be used to encourage the adoption of eco-friendly options, and the establishment of technological incubation. It has been hypothesized that the low numbers of and beverage bottles found in the waste stream can be attested to the fact that there is an effective collection system in place for glass beverage bottles (Idowu-Adegoke, 2020; FBRA, 2020; WeCyclers, 2020). This theory behind minimal glass numbers in the waste stream, the knowledge of informal circular practice, NESREAs desire to implement a circular system for post-consumer waste handling are all reasons to look further into the handling of glass beverage bottles as a solution to plastic waste issues. With the desire to reach the ultimate goal of zero waste (LAWMA,2020), solutions can be found in a myriad of places.

The concept and application of circular economy manifest in various ways in industry, ranging from renting schemes to product reuse and recycling, the end goal in all cases is to prevention resource disposal or extend lifecycles. However, this is achieved in some cases without the goal being to reduce carbon footprints or have environmental impact. In emerging markets, sustainable approaches may be chosen as it is the better option economically or socially, or even the only option at all and not out the desire to be environmentally sustainable. In Nigeria, the Returnable Glass Bottle process is a model used by beverage companies to ensure that glass beverage bottles are returned to the company. The success of this scheme relies on the active participation of the entire value chain. Distibutors, wholesalers, retailers, and consumers all play a role in ensuring that glass bottles are returned to beverage companies.

Recycling glass has unmatched environmental benefits and it can be done an infinite number of times without compromising its quality or purity (Why Recycle Glass? - Glass Packaging Institute, 2020). Notwithstanding the many known benefits of recycling glass, during initial research, and the literature review, limited information was found on the origin of and details of this scheme or process as practiced in Nigeria. Considering the extent of this practise in Nigeria, no review could be found on how it works, participation incentives, or, if the scheme is as a result of the implementation of legislation. When discussed, most individuals and even

interviewed stakeholders were aware of the practice and had participated in it, however, some were unaware of the status quo of the practice.

This research's aim is to provide definitive insight into a tried and tested nationwide glass bottle reuse scheme that has endured for decades. Although not a response to legislation, the reuse of glass has clear environmental benefits and this process holds untapped potential and a similar process could possibly be implemented with different waste fractions. An interesting and noteworthy feature is that the system is organic and there are no records to show that it was at any point in time a response to legislature yet, it continues to thrive with very little modification from the original set-up.

In line with the idea and use of the appropriate technology or approach to successfully implementing solid waste management and recycling or reuse schemes, it is important to analyse current, on the ground technology and schemes to gauge their relevance, use, and success before considering solutions, improvements, or applicability.

In this research, an investigation into current practice will be made, answers will be sought to discover the motivation for glass beverage bottle collection and the rate in which this is done. By further examining local practice and its sustainability, this case study "may be useful in the preliminary stages of an investigation since it provides hypotheses which may be tested systematically with a larger number of cases" (Flyvbjerg, 2006:230). The success and challenges that the glass bottle reuse provides could potentially serve as a springboard for application to plastic and other waste fractions. If the hypothesis proves correct and bottles are collected to be reused, the scheme of reuse can be considered a circular approach to glass use and exploration can be made into its sustainability. This can lead to further work as to whether this idea can be used for other solid waste fractions, particularly plastic which has similar use in the fast consumer moving goods industry.

This serves as justification for exploration of the practice of glass bottle reuse and the possible application of this reuse into the process for plastic bottle waste as this may lead to a reduction of plastic in waste streams

4. Research Question

Similar to how the informal sector in some cases is neglected and unaccounted for when formalised recycling is introduced, it is important to ask if there are already successful schemes that can be utilised or adapted as solutions. Can a conventional method for handling glass beverage bottles be revamped and used for plastics to solve problems caused by the environment's current menace?

This idea leads to the presentation of the following research question and sub-research questions.

> *"By exploring the returnable glass bottle process in Nigeria, what initial factors should be considered to replicate this circular business model to plastic bottles in the same market?"*

To guide research and provide answers that will lead to an outline of the factors that need to be considered, the following sub-research questions will be answered.

- How are glass beverage bottles currently handled in Nigeria?
- What are the current technique, knowledge, and organisational frameworks in place for the reuse of glass beverage bottles in plants and breweries?
- What technique, knowledge, and organisational framework will need to be in place for the reuse of plastic beverage bottles in plants and breweries?

4.1 Limitations and Research Boundaries

It is acknowledged that waste management is mandated by individual states and not the federal government, therefore, there are likely variations to the format used by LAWMA that is presented in the problem analysis. All the models for waste management by other states have not been addressed or presented in this research. Waste management is not the sole purpose of this report and is only addressed to explain the current state of waste flows and waste management. Another reason for focusing on Lagos is because Lagos state serves as an innovation hub for Nigeria and most ideas are trialled in Lagos and tailored for localisation in other states (Idowu-Adegoke, 2020; LAWMA, 2020; WeCyclers, 2020). In addition to that, many waste processing and recycling companies are headquartered in Lagos and waste and recyclables are delivered to Lagos for processing.

No literature was found that addresses the glass bottle reuse scheme. All information was gathered from interviews with individuals who directly deal with the scheme.

This research serves to outline factors for consideration and there will be no time to validate or trial these. However, suggestions for future works will be provided.

4.2 Research Design

To produce findings and information that aid, and support research goals and ideas, research methods and theory were selected to direct the analysis of information pertinent to forming a conclusion. The schema below serves as a visual presentation of how theory and methods will be used to present findings and supply solutions that answer the posed research question.

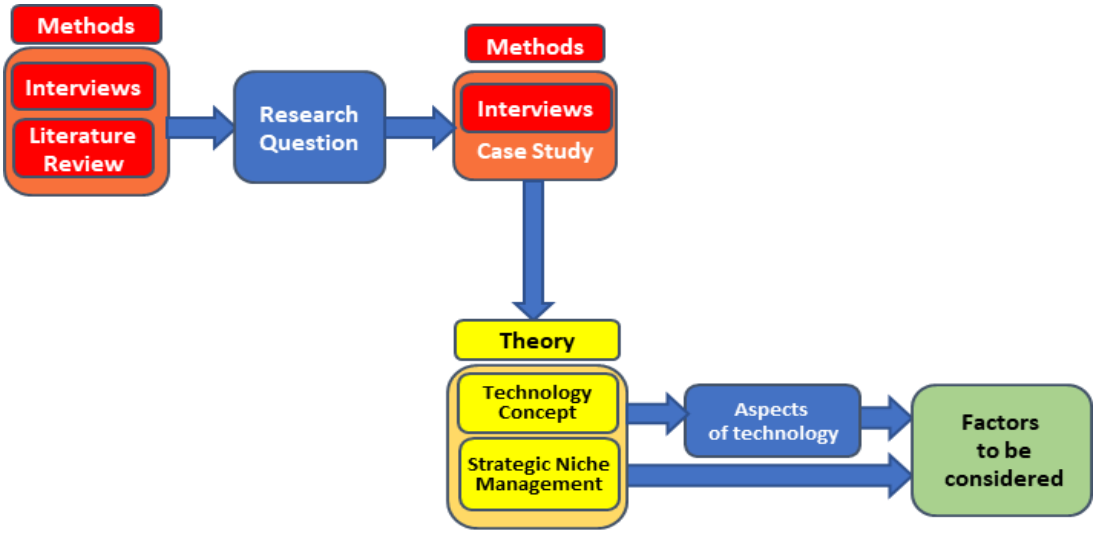

Figure 11: Visual representation of the Research Design

The literature review and interviews serve to outline the problem formulation and analysis. This leads to the research question. The research question focuses on glass beverage recycling and doing so allows for the use of a case study. The details about the scheme are gathered from interviews and are used to provide answers about the process of glass bottle handling. The findings are analysed using the chosen theories, the technology concept and strategic niche management. These serve to provide further insight and a framework for analysing the information gathered from interviews. These theories allow for the dissection of findings by framing the structure to outline factors for consideration that will serve to answer the research question, *what initial factors should be considered to replicate this circular business model to plastic bottles in the same market?"*

5. Methods

The purpose of this chapter is to elaborate on the means chosen to conduct this research. The overall aim of this project is to utilise an analysis of current practise to define factors for consideration when exploring the application of this circular practise used for glass bottles in Nigeria. Initially, a literature review was conducted to gather knowledge on the status, this was followed by interviews rooted in the case study that is being used as a critical case. To provide the reader with further understanding, photographs are used.

5.1 Case study

The case study proves hypotheses and theories by using real-life situations to develop a reality-based view. Use of the case study as a method allows researchers to learn from and gain knowledge and understanding from individual cases. In the process of theory-building, case studies are relevant for testing theories. A critical case has strategic importance to the general problem and the end goal for a critical case is to gain logical deductions from the information provided. These critical deductions being, "if this is (not) valid for this case, then, it applies to all (no) cases." This formulates characteristics that can apply to any, all, or some cases (Flyvbjerg, 2006: 230).

In this research, the case study method is used. The Returnable Glass Bottle (RGB) process is viewed as a critical case that can provide knowledge that can be used for plastic bottles as glass bottles and plastic bottles serve identical purposes. Eckstein (1975) (Cited in Flyvbjerg, 2006) argues that case studies are more valuable for testing hypotheses than they are at producing them. The advantage of using the case study as a methodology is that it closes in on real-life situations and tests views as they unfold in practice. The case study allows for the use of concrete experiences as opposed to predictive theory which does not (and probably cannot) exist in social sciences. Predictive theories and universals cannot be found in the study of human affairs and due to this, concrete, context-dependent knowledge is more valuable (Flyvbjerg, 2006).

5.2 Literature Review

A literature review was conducted to gather knowledge of the status of waste management, recycling, and the current handling of glass and plastic in Nigeria. Literature-based knowledge was gathered to form a basis of understanding of the status quo including any issues and viable solutions in the field and of waste management. The literature review included gathering knowledge about waste handling and recycling in comparable markets and economies. Much of this information was gathered in the UN-Habitat report which serves to compare index markets.

Initial literature focused on discovering Nigeria's interactions with the informal sector in waste management. This was widened to include the use of the formal sector. Literature also covered a search for current knowledge of circular economy, plastic waste issues, and glass bottle handling. From literature, conclusions could be made that there is an awareness of the formal sector and their practices. No literature was found that directly focused on the returnable glass

bottle scheme in Nigeria. However, literature did allude to the fact that waste that is collected by the informal sector is the largest contributor to recycling in emerging markets.

5.3 Interviews

In this research, the qualitative, semi-structured interview is used as the primary means for collecting data about the current process and the returnable glass bottle practice. The qualitative interview uses techniques that gain access to concepts, cultural understandings, and classifications of the world in the accounts of interview respondents. This type of interview focuses on the interviewer and interviewee's interaction and uses this to gain access to knowledge. The semi-structured interview approach retains flexibility but permits a degree of standardisation. The researcher asks generally open-ended questions and seeks open-ended responses that are used for exploratory studies (Kelly, 2010). The semi-structured interview allows for and reflects variations in the use of prompts and questions. By using open-ended questions, participants experiences can be channelled and utilised for research analysis and reflection (Galletta, 2013). The semi-structured interview is used in this research as it provides the researcher with the opportunity to ask follow-up questions and gain a fuller explanation (Kelly, 2010).

The UN-HABITAT report emphasises the necessity of including stakeholders of all levels to implement new technology and provide solutions for integrated solid waste management. Individuals and organisations are encouraged to be inclusive and lean into partnerships with stakeholders to introduce the best functioning solutions (UN-Habitat, 2010). To best reach and involve the multiple stakeholders involved in waste management practise, interviewees were asked to suggest stakeholders and individuals whose views may be pertinent to the study.

Interviews were conducted verbally via phone or other communication channels with various stakeholders. These stakeholders included individuals in waste management, those affiliated with beverage production, and consumers. This has provided further insight into the attitude, current practise, future goals, and the link between industries.

The interview guides for each stakeholder groups are attached as an appendix. However, as consonant with the semi-structured interview, the guide was not strictly followed. The purpose of conducting interviews was to investigate:

- The current state of waste management and recycling in Nigeria (including strategy and the role of the informal sector).
- The current state and knowledge of the returnable glass bottle scheme practise (including issues and successes).
- The general attitude towards waste management and recycling
- Opinions on the climate necessary for implementing changes in plastic bottle practice.

Participants for interviews were recommended by experts and sought based on their knowledge and experience in waste management, or their interaction with the critical case of the Returnable Glass Bottle process. The answers to these questions served as a basis for the current state and a means for analysis of the potentials of the system.

Due to the COVID-19 pandemic, interviews could not be held with informal recyclers. However as the focus of the research is not waste management by the informal sector, the perspectives

and integration of formal recyclers were gathered from literature and verified with interviewees who interact with this community.

5.4 Photographic Evidence

The researcher consulted with individuals to gather photographs where possible. This exhibits an accurate representation of current practise and provides the reader with a visual as not all readers may be familiar with some of these processes.

6. Presentation of Interview Findings

6.1 Returnable Glass Bottle Process

To gather information about the reuse of glass beverage bottles, beverage companies provided insight on their process in interviews. All interviewed stakeholders answered questions about their understanding and knowledge of the process used for glass beverage bottle recovery in Nigeria. In addition to the formal recyclers, LAWMA, and the FBRA, other stakeholders include a bar owner and a consumer.

A total of 4 beverage companies took part in interviews conducted for this research. One interviewee was unable to share details about their company's process but provided information about the use of returnable glass (RG) in the consumable goods market. Other interviewees expressed that interviews would be conducted with the understanding that these companies would remain anonymous or unrepresented. To keep to the companies' and interviewees anonymity, where necessary, participants will be referred to as, Company A, Company B, Company C, and Interviewee D. A total of 5 individuals were interviewed as two (2) participants from Company A provided information. One interviewee works directly with distributors and provided information about that process. All companies are in Nigeria and produce either alcoholic or non-alcoholic beverages packaged in glass bottles. All companies interviewed also produce beverages that are packaged in PET bottles.

Each companies' glass bottle reuse process is similar and there are minimal differences in their approach to glass bottle collection, reuse, and preparation for reuse. During interaction with beverage companies, it was identified that the reuse of glass bottles is formally known as the *Returnable Glass Bottle (RGB)* process/scheme or *Returnable Bottle Process* and will be referred to as these interchangeably in the report.

6.2 Overview of Returnable Glass Bottle Process

The Returnable Glass Bottle (RGB) process of each brand dates as far back as their inception into the Nigerian market. The presence of these companies in Nigeria has spanned over decades and the process of reusing glass bottles is not an innovative approach but is a historical market practise that is integrated into their business models. The process is utilised in large beverage companies and has an effect throughout the value chain from the brewery/plant to the distributor up until the consumer. Each leg of the chain works to ensure that bottles are returned and cycle their way back to the brewery to be refilled and have the process repeated.

The goal of the returnable glass bottle (RGB) process is for the brewery, or plant to collect glass bottles back from distributors, and refill these glass bottles with the proper liquid. In a sense, the distributor (and subsequently, those in the value chain) only purchase the liquid content

from companies as the glass bottles (and crates) are viewed as company assets/property and need to be returned. To become a distributor or wholesaler who purchases from the brewery, empty glass bottles (referred to as empties) or a cash deposit are required to serve as collateral. Obtaining collateral or empty bottles is a necessary step to proceed. This same model is passed down the line as wholesalers and retailers also require deposits or crates and bottle exchange from their consumers. Although, the details of the way the scheme runs may differ from company to company, the general idea and model remains the same. The idea of the model is that a worth or value is set for glass bottles (and crates), and that value is not returned to the buyer until the product (empty glass bottles and crates) are returned to the brewery or plant. This same model is mimicked across the value chain and is done to protect the business' assets and ensure that glass bottles are returned.

Interviewee D (2020) describes the process as a business model and not a scheme. They summarise the model by explaining that:

> "It's quite simple, RG is glass reused by the manufacturer to house their products for selling. Typically, these glasses can either be sold to the company's customers or given to them with some sort of agreement that holds the tenure the customers is still in partnership with the company. For every sales order placed on the RG SKUs, the company delivers the product bottled in the RG and retrieves empties that the customer would have accumulated over time. Usually, the glass returned should be like for like, i.e. SKUs delivered (quantity and type) = SKU [2] glass empties received (quantity and type). The delivery person then brings the same back to the production centres or warehouse, where they are checked and prepared for production"
>
> (Interviewee D, 2020).

The main purpose of using this scheme is profit and cost-benefit (this appeared to be the answer all interviewees provided). One interviewee also adds that the bottles pay for themselves over time (interviewee D). By returning glass bottles to the plant or brewery, companies do not have to appropriate funds to purchase glass beverage bottles. Instead, funds are used for logistics (picking up and sorting empty bottles) and cleaning. As glass can be infinitely reused by being washed and sterilised, this makes them ideal for reuse and is a practical approach to cost savings. There is also a small market available for purchasing new glass beverage bottles, and by reusing bottles, this ensures that there is less of a demand for new bottles from glass manufacturers. The reuse of glass bottles leads to energy savings, minimises waste, and reduces the carbon footprint of beverage companies', as fewer resources are required to reuse glass beverage bottles than to create or manufacture new ones.

6.3 Details of the Returnable Glass Bottle Process

The RGB process entails placing a financial cost on glass bottles and passing this down with the bottles as they make their way across the value chain. The process presented is based on

[2] SKUs is an abbreviation for stock keeping unit. The term is used in inventory management.

findings from interviews conducted with 4 companies in Nigeria that practise the Return Glass Bottle (RGB) process.

Plants and breweries coordinate with glass manufacturers to create glass bottles that meet the size, shape and, colour requirements for bottles.

When asked about the RGB scheme, one interviewee provided a summary of how the scheme works. This explanation was provided

> "It is a business relationship with customers, we supply them with a glass with a margin on it and then the margin is paid back to them when we get the glass back. It is us supplying and getting it back, this is done is sizable quantities. Hundreds of cases are supplied at the same time and hundreds are collected back from outlets. And for the reusable, there is only one source and those outlet distributors and we supply to them directly and they redistribute with that same margin on the glass to their customers so then it is netted off when they get theirs back"
>
> (Company C, 2020).

Initially, as mentioned, bottles are obtained and used as an exchange for products. These bottles can be purchased from the brewery or the "black market". Bottles can enter this space from the large retailer channel (as they are not required to return bottles) or from companies who no longer purchase beverages or did not return bottles as selling them is equally if not more profitable. In many cases, it is even advised to go this route as it is a cheaper option for obtaining empty glass bottles (Company A, 2020).

These empty bottles are replaced with bottles with full liquid content. Once beverages are purchased from the plant or brewery, the full bottles are provided in exchange for empty bottles and crates or, a deposit is made and bottles and crates are supplied to the distributors with the expectation and understanding that they will be returned.

Once full beverages are sent into the market, a similar process is also carried out between distributors, wholesalers, and retailers.

In an interview conducted with a bar/grill owner, the process was explained.

> "I do work with a wholesaler… I send my order. The wholesaler brings it to me… if I take 5 cases[3] of [x], I have to replace it with 5 empty cases of [x]. If I need 5 cases of [y], I have to replace it with 5 cases of [y]"
>
> (Bar/Grill owner, 2020).

Following this exchange, the same responsibility is passed to the consumer.

> "If you want to take bottles away, you come with the same number of bottles you want to buy. If not, you come with a deposit and the cash deposit will definitely make sure you come back, trust me…If we know you personally, we (might) let you take the bottles but that doesn't really pay us. They won't bring them back."
>
> (Bar/Grill owner, 2020).

[3] Cases and crates are the same. These are the measurement for selling drinks and also the container they are transported in.

The interviewee went further on to explain that there is no set standard value placed on bottles at their establishment. For them, this varies depending on their relationship with the customer. However, with the wholesaler where they purchase their beverages, there is a set deposit amount per crate.

Once a consumer, retailer, wholesaler, or distributor is done with their purchased beverage, that is, once the liquid content has been consumed, efforts are made to return these bottles to the appropriate party. This is done as an exchange, empty bottles for full bottles or a deposit return. Bottles are expected to be returned in the right condition or with minimal damage or defects on the bottle. Once these bottles have made their way back up the value chain from consumer and back to the brewery, these bottles are exchanged for full bottles or a return of deposit (or whatever has been left as collateral).

To elaborate on the collection and what classifies as a proper return, one interviewee explained that, "the glass and the crate are married and are one" (Company A, 2020). The interviewee further explained that attempts to return incomplete crates are classified as invalid returns (Company A, 2020).

Accepted empty bottles are counted, sorted, and inspected before an in-house process begins to start bottle preparation for reuse. Bottles are, checked, washed, and sterilised to ensure that they are in the right condition to be refilled. When returned to the brewery, glass bottles collected are inspected for damages and completeness and to ensure that they are sorted properly. Sorted glass bottles are cleaned and then sent through the process used for washing. In this stage, glass is washed and sterilised for reuse.

One interviewee describes the bottle cleaning.

> "In a normal production line, you have the bottle washer, it is the machine that washes the bottles using hot water and caustic soda. It cleans the bottles of both organic and inorganic soils. Once that is done, it is clean and then goes through another machine that is called the Empty Bottle Inspector (EBI), it is [a piece] of electronic equipment, it checks the bottles for different kinds of things. It checks the bottles for dirt inside and outside, it checks the bottles for residual liquid, it checks for cracks, it checks the bottle for scuffing, it checks for a lot of things and if it sees any with any of the things I mention, it knocks it off or breaks the bottles so it is the clean and presentable bottles that go to the filler for refilling to then be sold" (Company B, 2020).

After washing and sterilisation, glass is inspected and all glass bottles that are not appropriate for refill are discarded. Discarded glass bottles that are not deemed as fit for refill are not reintroduced into the cycle. Instead, these bottles are collected in house and crushed into cullets. Arrangements and agreements are made with glass bottle manufacturers to collect and recycle these cullets for reuse. Some of the variables that render glass as inappropriate for refill include scuffs, discolouration, excessive scratching, chips, and breakages. All interviewees expressed that the crushed glass is purchased by glass manufacturers and then reused to make glass that these companies purchase. One interviewee further expressed that the retrieval of cullets is a process that is used to offset the purchase of glass from the manufacturer by the brewery (Company B, 2020).

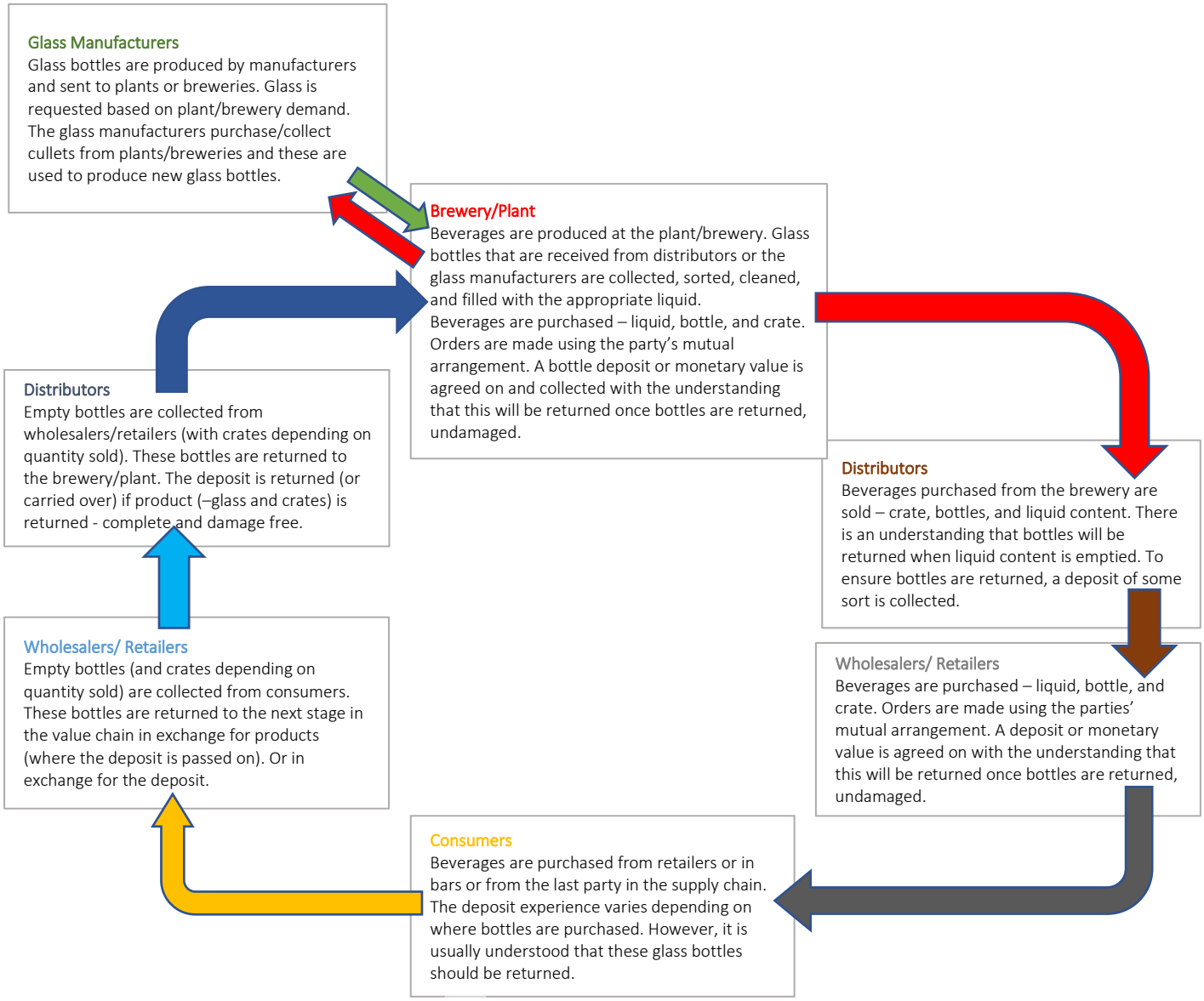

Figure 12: Visual of the Returnable Glass Bottle Scheme

6.3.1 Exceptions to glass bottle refiling / Reasons for bottle ejection

Although the general idea for glass reuse is standard and correlates with the above, in addition to the minor variations of the in-house process between breweries and plants, there are other exceptions to when glass bottles are not refilled or reused. Bottle ejection refers to new bottles being released or purchased from the glass manufacturers.

Large retailers

In addition to the regular distribution process, there is a separate chain of distribution that is used with large retailers (this is also referred to as the "big store" channel). For this channel of distribution, a deposit is not required, and the amount of the glass bottles is factored in with the cost of the liquid. There is no difference in the product purchased, however, the negotiations are different, and this allows for these retailers to not have to collect products

(empty bottles/empties) from consumers. One of the companies interviewed is working on logistics for a scheme that will allow customers to receive a discount on any of the company's brands if empty bottles are returned are currently in progress. As these bottles are the same as the returnable glass bottles, they can also be used in an interchange of the product by consumers.

Equivalent Bottle Value exchange

It appears that bottle exchange is not solely done by exchanging bottles for exact equivalents. Rather, in exchange for bottle A from company A, bottle B, also produced by company A can be an acceptable alternative that holds equal value (Bar/Grill owner, 2020).

Bottle changes and redesign

Every so often, bottle companies change their bottle design by varying its shape, packaging, or logos. In this case, the bottles are not refilled and collected bottles are crushed to be turned into cullets that are sent to glass manufacturers. In the value chain, distributors and the companies work together to gather old bottles and ensure that redistribution and product change is done so appropriately. This is usually governed by a final date to turn in a product. Postdate, the product is no longer collected, and it is redundant and no longer serves any benefit for the company. If collected, it is to be crushed and sent to the glass manufacturers as cullets (Company B, 2020).

Availability of stock

A bottle cycle is about 4 weeks (Company A, 2020) and if the bottles are not being returned at a fast-enough rate, companies may ask manufacturers to create new bottles and these become a part of the rotation. This could be for many reasons one being that consumers are not purchasing beverages at the estimated rate (Company B, 2020).

Damages

Bottles that are damaged or no longer suitable for refill by the brewery or plant are ejected from the process, crushed into cullets and sent back to the manufacturer for recycling. Damages to bottles include scuffs, chips, and bottle breakages. These in addition to cracked or broken bottles are not recommended or approved for refilling. These bottles are identified by the Empty Bottle Inspector (EBI) which identifies bottles that are too damaged to be refilled and ejects them from the process.

6.3.2 Laws and regulations

There currently are no laws or directives that require beverage companies in Nigeria to enforce glass beverage bottle reuse schemes. However, directives and regulations are to be followed when refilling glass beverage bottles. Although not much detail was given about regulations, they are in place and govern safety and standards. The following were mentioned as bodies and regulatory agencies that perform checks; Nation Agency for Food and Drug Administration Control (NAFDAC), Standards Organisation of Nigeria (SON) and, National Environmental Standards and Regulations Enforcement Agency (NESREA).

6.3.3 Issues with the current system

Other than the inevitable wear and tear or other factors that prevent bottles from being returned and reused, interviewees were asked how the current regimen could be improved and this led to an identification of issues.

Interviewees identified proper bottle treatment as a way in which the process could be improved. It was identified that the proper treatment of bottles is imperative to ensure success in this system. Bottles that are not properly cared for or treated cannot be returned and this can cause complications when attempts are being made to reuse the product. This can lead to bottle ejection, forcing bottles to be destroyed and prematurely turned into cullets limiting bottles from being used to their maximum potential.

Another issue is the large retailer channel. Although the cost is factored into the negotiations for purchase, bottles that are sent to large retailers do not have a direct stream or route that ensures that these bottles are returned to the brewery or plant.

6.3.4 Solutions to Issues

For the maltreatment of glass bottles, one interviewee mentioned the need for proper consumer education. By sensitising consumers to the economic and environmental implication of abuse and maltreatment of bottles, this could prevent them from using them for other liquids including paint, or even from putting candles in them. Currently, distributors do sit through training, however, the interviewee expressed that they are not sure of what extent that this training covers. Although they are aware that bottles do have signs, these do not deter users from misusing products, and signage does not cover all the effects and misuses (Company A 2020).

As mentioned, for the bottles distributed to the larger retailers, there is work being done on a scheme that allows users to exchange bottles for discounts on all products produced by that company. The hope and goal are that this will increase the number of returns.

6.3.5 Variations in company processes

One company mentioned that its process also includes labelling. After bottles have been refilled, they are relabelled as the labels are removed during the washing phase.

The longevity and service duration of each bottle is dependent on the bottling company. The length of time that companies keep their bottles for vary and the range of time mentioned. The policy varies and the range of longevity can be as little as five uses due to discolouration which deems the bottle unacceptable for refilling (Company C, 2020) or up to 20 years as one interviewee recalls seeing a bottle from 2000 on the line in 2020, equating to 20 years on the production line (Company B, 2020).

One of the companies also expressed that in addition to the Returnable Glass Bottle process, they also have another glass bottle collection program. To reduce the number of counterfeit products that make their way into the market, they have introduced a glass collection scheme for their spirits and other glass beverage bottles. Usually and based on company protocol, spirit bottles are not refilled. However, by not collecting these bottles, counterfeiters have access to these and refill them for resale. In this prevention scheme, glass is collected from large venues

like bars and recreational centres that sell beverages. Once this glass is collected by the company's recycling partners, it is brought back to the brewery to be crushed into cullets. These cullets are sold to the glass manufacturer to be recycled. This program serves a dual purpose as it is also done in collaboration with their corporate relations and sustainability team as they partner to reduce the waste their products produce (Company C, 2020).

6.4 Summary of Findings

The presentation of findings serves to answer the sub research question:

"How are glass beverage bottles currently handled in Nigeria?"

According to data collected from interviews regarding the glass beverage bottles used in the returnable glass bottle scheme or model, glass beverage bottles in Nigeria are treated as company assets. The collection and reuse of glass beverage bottles is not done as a response to legislation but has been incorporated as a cost beneficial business model. Beverages sold to consumer are housed in these glass bottle containers that serve as business assets. In exchange for the assurance that this glass will be returned to the business, a deposit or tenure is placed on the bottles and only returned in exchange for bottles. The reapplication of deposit to subsequent orders is also an option. This same tenure and deposit idea is replicated across the value chain to ensure that each wrung of the ladder receives these bottles from their consumers.

Upon return, these bottles are washed and refilled to be returned to the cycle. If there is ever a need for bottles to be ejected and removed from the loop, they are crashed into cullets and given to the glass manufacturer who uses this to create new glass that will also be introduced into the cycle. This model has been utilised for several years and continues to be used as it has proven to be a cost-beneficial process.

7. Theory-based Analysis

The coalescence of the selected theories, the technology concept, and Strategic Niche Management (SNM) are employed in this research to analyse resource management as it presently applies to the Returnable Glass Bottle (RGB) process. The theory outlines existing practice and will serve as a guide for the factors necessary for consideration to encourage the adaptation of this laudable process to plastic beverage bottles.

7.1 Technology Concept

Technology consists of four inseparable aspects which are interrelated and require review before the introduction of new technology into an environment. Technology, in this case, refers to how humankind reproduces, expands and improves their living conditions. The four components that are combined for technology modelling are technique, knowledge, organisation, and product (Müller, 2011). Jens Müller presents the Technology concept along with the relevant and inseparable aspects of technology.

To make an appropriate analysis based on the current system, a conscious decision to decline the adoption of a mere 'plug and play' of ideas is paramount. The relevant technology must be viewed holistically as all aspects must be considered including its application to a given environment or situation. Although there is no specific one-to-one deterministic relationship between the four variables of technology, “a qualitative change in any one of the components will eventually result in supplementary, compensatory and/or retaliatory change in the others. If this does not happen, the initial change initiative will become abortive” (Müller, 2011:11).

Below is an explanation of each aspect of the technology model.

Aspect of Technology	Definition
Technique	This refers to the raw materials, components, physical implements, or hardware and, energy inputs that are transformed or consumed in the process. Physical labour is the necessary factor for setting off this process.
Knowledge	This is comprised of information input processing. The main component of knowledge is the software, and this is structured by empirically acquired skills, tacit knowledge, and intuition of the direct producers along with, the scientific insight and creativity of the technology designers.
Organisation (Technology as an organisation)	The org-ware is the component of technology that makes up the internal division of labour and the patterns of specialisation are central to the structure of the organisation. The counterpart to the division of labour is co-operation. This requires coordination and management and involves all kinds of communication processes.
Product (Technology as a product)	Product is the result of combined knowledge, organisation, and technique and can come in infinitely different kinds of shapes.

(Müller, 2011).

Table 1: Presentation of Technology aspects and their definitions

The aspects of technology that make up the returnable glass bottle process are presented below to provide a clearer understanding of the details that allow for the scheme's success. This is based on the findings gathered in interviews and presented in the *6. Presentation of* Interview Findings section. The focus for this section is primarily to highlight the technique, knowledge, and organisation that comprise the final product – returnable glass beverage bottles. This also answers the sub research question, *"what is the current technique, knowledge, and organisational framework that are in place for the reuse of glass beverage bottles in plants and breweries?"*

Technique

The elements of technique are the labour and physical aspects that are necessary to accomplish the final product's overall goal. For the RGB process, the goal is to produce beverages in glass that can be reused and recirculated in the market. The reuse of glass bottles is primarily to reduce production cost but subsequently, results in waste reduction and energy savings. The physical elements other than glass that must be present for the technique to be successful are the washers, glass cleaning machines, the crates used for transporting, the glass bottle itself and the labour necessary to perform these tasks. The labour comes into play in the distribution process which is accomplished by delivery drivers, plant workers, and all those involved in the process that goes into transporting bottles to and from distribution locations, returning them to the brewery, cleaning them, and preparing them for output.

One particularly essential aspect of the physical ware identified in interviews is the Empty Bottle Inspector (EBI). The EBI is a standard feature installed as part of the line to determine the suitability of each bottle for refilling. The EBI serves to fulfil policies as its functionality is checked by regulators during inspections.

Other indispensable physical elements of the Returnable Glass Bottle process include the glass bottles, the crates that are included in the "rental" of these bottles and used for transportation are also specific to the scheme as the glass and the crates come together. However, it should be noted that consumers can purchase individual bottles.

Figure 13: Image Depicting the transportation of crates and bottles (Nairametrics, 2019).

Knowledge

Knowledge is the software used and empirically acquired skills, tacit expertise and intuition of the direct producers and the scientific insight and creativity of the technology designers. It is comprised of information input processing (Müller, 2011). Knowledge essentially consists of how those who work with the product or technology are aware of how to utilise and perform technology centred tasks that result in achieving the end goal of the product, and how they gather the ability and know-how to perform the tasks necessary for achieving the technologies' goal.

For the Returnable Glass Bottle process, the structure of the process and how it is done or carried out includes an understanding of the pricing along with the way that the bottle reuse process is conducted. The knowledge of the use of the scheme is found in brewery/plant workers, distributors, and retailers. The know-how and participation from the consumer point of view in most cases has become a cognitive routine. All individuals interviewed do not know how they became aware of the scheme but, grew up with the knowledge and understanding of the practice. The tradition is most likely observed or passed down orally by individuals to the community as there is no knowledge of a formal guide or process for obtaining this information. The knowledge for those in the distribution value chain may be formally passed from the plant or brewery as this may be included in contracts or purchase agreements. As far as known, there are no official or public means to gather this information.

Organisation (Technology as an organisation)

Central to the structure of the organisation is the org-ware which is the internal division of labour and the patterns of specialisation. This requires coordination and management and involves all kinds of communication processes. The counterpart to the division of labour is co-operation. It centres around the way things are done and includes the actors necessary for achieving these goals (Müller, 2011).

The org-ware for the Returnable Glass Bottle process consists of the people in the value chain. This includes the glass manufacturers, the individuals that work on the lines and run the machines, and the people who carry out the checks when products are brought back. It also includes the retailer who passes along information to the final consumer. Across the chain, various actors make the difference in the way that this process is carried out. Without the org-ware, the system would not be functional as the need for humans and the org-ware are imperative for the products' success.

Product (Technology as a product)

The result of the combining knowledge, organisation and technique is the technology as a product and this takes various shapes (Muller, 2011). In some cases, the technology is a service, at other times it is a physical product. The overall end goal and what is available as proof for achieved work. The final product as technology is what you sell, or the service rendered.

In this case, the product is returnable glass, along with the process that is used to ensure that the glass bottles make it around the loop from glass manufacturer to the plant or brewery and back to the glass manufacturer. The idea of the product is a process that places value on the

packaging and provides consumers with beverages in glass bottles that are essentially on loan from the company. The product that is provided to the consumer is liquid content in a glass bottle. The liquid content is to be consumed but it is expected that the glass bottle is returned to the beverage company.

7.1.1 Application of the technology concept

For the application of the technology concept to plastic bottles, each aspect of technology that would be necessary for the product's success will be described below.

This also serves as an answer to the sub research question,

- *What technique, knowledge, and organisational framework will need to be in place for the reuse of plastic beverage bottles in plants and breweries?*

Aspect of Technology	Application to Plastic Bottles
Technique	The raw materials, components, physical implements, hardware and, energy used here would be the machines that are used to clean the plastic bottles or repair them to be reused. This would also include the energy source. The physical labour is the necessary factors used for carrying out this process. In this case, it would be the individuals who transport bottles from one location to the other and machine operators. The technique for plastic bottle reuse would be embedded in the physical aspects that allow for this innovation to take place.
Knowledge	This is comprised of information input processing. The main component of knowledge, the software would be structured by those working or overseeing the plastic bottle reuse. The empirically acquired skills, tacit knowledge, and intuition of the direct producers, in this case, would be what is used to achieve the goal of the technology. The knowledge would be factored into the logistics and how the process works or how it unfolds. The scientific insight and creativity of the technology designers also would be accessible by those who create and operate the scheme. For plastic bottles, it would include deciphering exactly how this would be done or carried out including an understanding of what correct pricing should be and how the scheme would need to be executed. The knowledge of the scheme would most likely lie with the brewery and plant workers, plastic manufacturers, and beverage distributors and retailers. The knowledge of the use and how to participate in the scheme would also need to be understood by consumers for it to be successful.

Organisation (Technology as an organisation)	Each level of production is composed of those who would make the scheme possible. This requires coordination and management and involves a variety of communication processes. The org-ware for returnable plastic bottles would consist of individuals across the value chain; people on the production lines who operate the machinery and any other aspect that may need to be in place. It may even be possible to have the org-ware consist of technology that can be used to make checks currently carried out by people. (This could also be seen as the technique depending on how it is used and viewed). The org-ware includes the consumer as their participation is necessary for success.
Product (Technology as a product)	The product is the result of combined knowledge, organisation, and technique (Müller, 2011). Here, the product would be a reusable plastic bottle scheme or process. That is, the plastic bottle itself being reused by the manufacturer as packaging. The overall product is the reusable plastic bottle process along with the procedure used to take plastic from where it is consumed back to the brewery where it is prepared for reuse, reused, and then recirculated into society.

Table 2: Aspects of Technology applied to plastic bottles

Muller's work is focused on evaluating the use of foreign technologies in new social settings. The idea is based on the misfits that occasionally present themselves when ideas from the global North are not successful in the global South. This is due to misunderstandings and the way that many of these innovations are translated into their new social setting. The following options are often used to solve the problem.

> "Option 1: The technology being supplied is fully adapted to the social setting of the receiver.
> Option 2: The social setting of the receiver is fully adapted to fit the technology supplied.
> Option 3: Both the technology supplied, and the social setting of the receiver is changed or 'moved' to fit each other at some point, which hardly can be pre-determined"
>
> (Müller, 2011:15).

Considering option 1, it can be said that any "appropriate technology would, most often, already be there" (Müller 1980) (as Cited in Müller, 2011:15). While this is true, in the case of the Returnable Glass Bottle process, the social setting has changed. Although it is within the same physical setting and the implementation is done in the same country, the social setting has changed as there has been an introduction of, and an increase in the use of plastic for packaging beverages. In alignment with Strategic Niche Management, option 2 gives reason to not solely explore foreign options as solutions but to delve into existing schemes and see how they can be used. It is important when creating a niche to be aware of the other exogenous actors and the necessary changes that need to be made to the landscape to influence the regime and thus allow for growth of the created niche and the implementation of the technology.

On the regime level alone, there are many variances in cultures and countries that lead to social differences that need to be considered when creating and adapting the technologies concepts. For example, many countries do have a reusable plastic bottle scheme in which they utilise reverse vending machines to collect plastics. The idea of reverse vending machines for plastics has been posed in Nigeria and the main concern is how to properly localise the idea for the diffusion of the innovation (FBRA, 2020). Option 1 involves localising ideas as the technology is adapted to the social setting and local conditions accordingly.

The 3rd option presents a problem as hardly ever can any of the changes necessary be predetermined.

In this case, although we are dealing with a technology change, the transfer is within the same social setting. However, the four components – knowledge, organisation, technique, and product will differ, and it is important to analyse these and how they can be received and integrated into the social setting. The initial change is the product, this leads to a change in all of the other components.

7.1.2 Infusion of Technology

For the infusion of a technology to occur, six conditions must be fulfilled. The actor unit and those involved in the organisation component must have:

> " *1. Interest in applying the technology, i.e. be motivated to obtain and operate the technology.*
> *2. Power to materialise its interest, i.e. have the required socio-political and economic means.*
> *3. Organisation to exert the power to establish the necessary internal conditions for applying the technology and must be affiliated with an interactive external task network. The unit must further have:*
>
> *a. Information about the technological options, i.e. be able to assess the potential alternatives in relations to the desired need fulfilment.*
> *b. Access to the technology in question, i.e. be able to obtain and procure the hard- and software of the technology.*
> c. *Knowledge about how to operate the technology i.e. can handle the required technique and work organisation*."
>
> (Müller, 2011:19).

Further insight and evaluation of these will be provided below:

1. *"Interest in applying the technology, i.e. be motivated to obtain and operate the technology" (ibid).*

The technology must be appealing to the organisation. In the case of translating this to plastic bottles, the company must be willing to delve into research and design and be motivated to consider this option. The interest may come in many different manners. There could be a push rooted in political agenda and/ or the possibility of financial gain. As seen with RGB process, where although there are environmental benefits, the main motive is cost savings. However, a

change in the landscape and discourse to incorporate sustainability could lead to an interest in applying this technology to plastics.

2. *"Power to materialise its interest, i.e. be in possession of the required socio-political and economic means" (ibid).*

This lies in the hands of the actors who serve as major change-makers who control the company's decisions and responses and have the power to materialise technology shifts. The socio-political means, however, lies with other stakeholders. That is anyone who can create and affect the social-political aspects. Examples in the Nigerian context that would affect the embedding of this technology include the FBRA who play a role in connecting many of these companies, SON, the Standards Organisation of Nigeria who is working to create a standard for RPET. Other holders of socio-political and economic power include the regulatory boards and consumers. During interviews, some stakeholders expressed that packaging is controlled by consumer desires. If this is the case, consumers have the power to influence the social setting by pushing for companies to make product packaging more sustainable.

3. *"Organisation to exert the power to establish the necessary internal conditions for applying the technology and must be affiliated with an interactive external task network. The unit must further have:*

    4. Information about the technological options, i.e. be able to assess the potential alternatives in relations to the desired need fulfilment.

    5. Access to the technology in question, i.e. be able to obtain and procure the hard and software of the technology.

    6. Knowledge about how to operate the technology i.e. be in possession of the capability to handle the required technique and work organisation" (ibid).

As the technique and knowledge, (and ultimately all four components) must change or adapt from the status quo for plastic bottle application, the organisation must be able to properly coordinate and make changes and to do so, the above must be considered. It is important to gain an understanding of the alternatives that fulfil this need and are currently in the market along with the preferences for choosing these options For returnable plastic/PET bottles, it appears that this technology and it's hard and software does not yet exist in this social setting, it is, therefore, necessary to obtain this. Once this technology is in place, it will lead to a development in the knowledge of its operation.

7.1.3 Five phases of the innovation process

When considering the infusion of a product, the technology must go through the five phases of the innovation process to ensure that the innovation occurs. These identified phases along with how they can be adapted are presented below.

1. *Basic Research* is the first step, and this is where the ins and outs of the phenomena are discovered. This phase is strongly constituted in the science of the phenomena (Müller, 2011). The application of basic research in this instance would begin with discovering the properties of plastics and identifying the similarities and differences between plastic bottles

and glass bottles. The identification of properties will allow for solutions to be embedded in the science behind each factor and prevent ideas from being transferred incorrectly from one product to the other. The goal of the research can begin from anywhere as the purpose is to gather an in-depth understanding of a technology's science.

2. *The Development phase* is where applied research is done to discover new products and processes. Here developmental concepts are formed for new processes and products and the know-why emerges while the knowledge is constituted (Müller, 2011). In the case of plastic and glass bottles, this phase is important as it allows for further development and exploration.

3. The *Formation phase* focuses on the technique of the technology. New processes are created with prototypes as the engineering aspect is catered to (Müller, 2011). Here, the basic research is applied as a process is created where the knowledge aspect from the development phase is employed For the plastic bottle's application. this phase would consist of the creation of a reuse process and the correct technique that would allow for such to be implored.

4. In the *Application phase*, the know-how is used for production as the mode of operation is decided and used (Müller, 2011). This phase includes the rolling out of this idea as the org-ware becomes involved in setting up and ensuring that this phenomenon unfolds and is embedded in society.

5. A materialised product is apparent in the *consumption phase*. Here, the marketing and know-who is involved (Müller, 2011). For plastic bottles, this phase includes an introduction of returnable plastic bottles in the market. In the phase users and consumers will begin to imbibe the practice of returning plastic bottles for reuse by companies as beverage bottles

Technology theory also considers the idea that the way a technology is shaped and embeds into society depends on the cultural meanings and social negotiations. The idea is that technology is created and then adapts to and adopts as a reaction to the needs and conditions presented by society. Here, the returnable glass bottle scheme has been adopted by and adopts the way that people do business and forms a cognitive routine. The society has also adapted to the technology. Although, part of the reason for the original success of the technology, could be that the idea of material reuse has already been a part of the culture. Just as technology influences human life, human beings influence the creation and development of technology. Oduol (1995: 303) (as Cited in Müller, 2011). For the application of this to reusable plastic bottles, the technology and the society will respond to one another as the scheme upon creation is set to be infused into the landscape.

7.1.4 Endogenous Technology

The term endogenous inspired by Fals-Borda & Mora-Osejo (2003) (as cited by Müller, 2011) means 'growth from within'. Müller argues that "endogenous knowledge systems or technology should not be understood as a call for a return to or glorification of a static past but … an active engagement with the present and future situation" (Müller, 2011). Although the

exact origins of the Glass Beverage Bottle process are unknown, it is now a 'locally embedded' system and business model that has contributed to and has roots in the culture and landscape. By focusing on this known method as a way to reduce waste pollution, it ventures away from using exogenous means with foreign origin that require the technology's social setting to evolve for diffusion. With endogenous technology, the knowledge needed is locally available and disseminated in the society; and "the organisation of the production is embedded in the local institutional setting" (Müller, 2011).

Müller writes:

> *"The term endogenous is used without reference to a historical perspective. It has to do with local control over and accessibility to a knowledge system that enables people to use, reproduce and innovate their technology; using their creative ideas and available resources to be inspired to mix the local with external knowledge at different levels of society; and by so doing, constantly reproducing and transforming the endogenous technology"*
>
> (Müller, 2011:23).

In the case of applying a similar technology to the use of plastic bottles, the knowledge and organisation only evolve and are not subject to a structural change but an adaptation. The way the process is executed amongst actors should theoretically be the same. The current knowledge is locally controlled, and the social setting remains the same. There is, therefore, access to a knowledge system that can be adapted. The innovation aspect of this technology lies with the technique and product resulting in plastic bottles that can be returned with minimal damages and have a process in place for reuse.

7.1.5 Summary of Technology Concept

The technology concept aids in the identification of the four aspects of technology. These four aspects – technique, knowledge, organisation, and product need to be developed accordingly to ensure that any changes in one aspect are reflected for the remaining. For the application of these technology to plastics, the technique will evolve to focus on plastics, the knowledge will change as the application is to a different product and so will the actors. The overall product will vary and focus on plastic. The technology must go through the five phases – basic research, development, formation, application and consumption to become an infused technology. These phases will only work as a response if the six conditions for a technological infusion are met.

By focusing on the technology model framed by the technology concept, it allows for endogenous growth from within as opposed to exogenous growth that may not be suitable for the social setting.

7.2 Strategic Niche Management (SNM)

Strategic Niche Management (SNM) is a socio-technical transition theory that provides a governance and normative approach to multilevel perspective theory used to analyse transitions. Use of SNM recognises the important coevolutionary role that technology, institutions, social and, economic systems play (Twoney and Gaziulusoy, 2014). SNM focuses on endogenous steering from within a niche by a range of actors, including users and societal groups. This steering and selective exposure can lead to the replacement of technologies. It is used to ensure that embedding a technology or an idea into broader societal goals is not left to a later stage that can lead governments to mitigate and/or compensate for the impacts of inserting technologies or sustainable innovation (Schot and Geels, 2008).

The following describes the necessary stages and components for a transition to take place.

Level	Description	Elements
Landscape level (Macro)	This aspect of the Multilevel Perspective consists of the deep cultural patterns, macroeconomics and political developments that make up the environment. These tend to be structured and difficult to change (Twoney and Gaziulusoy, 2014). The macro-level is formed by the socio-technical landscape, an exogenous environment beyond the direct influence of niche and regime actors (e.g. macro-economics, deep cultural patterns, and macro-political developments (Schot and Geels, 2008).	Cultural patterns Macroeconomics Macro political development
Regime level (Meso)	This level consists of cognitive routine, belief systems as well as regulative rules and normative roles. The structures in this level represent current practise and routines which are a response to the rules and technologies that dominate the system and provide stable reinforcement of the socio-technical systems (Twoney and Gaziulusoy, 2014).	Regimes, Rules and, regulations Industry Science Culture Technology Market/user preference Policy
Niche Level (Micro)	This level of transition takes responsibility for providing a realm for radical novelties to emerge (Schot and Geels, 2008). In this level, the structure is unstable and loose, actors are not particularly coordinated, and this allows for the emergence of new interactions. (Twoney and Gaziulusoy, 2014).	Network of actors Learning processes

Table 3: Strategic Niche Management definitions

To gauge the applicability of technology, it is important to view the socio-technical landscape in which the technology, a means by which mankind reproduces and expands its living conditions is being presented (Müller, 2011). The use of Strategic Niche Management can serve as a tool to analyse the factors in place. The post ante tool can be utilised to view the former

changes in the landscape and niche developments that exist that allow(ed) or discourage(d) the alignment of innovation with a regime. Multilevel perspective ensures that the actors and aspects that are necessary to implement technology are considered. Strategic Niche Management allows for niches and landscapes to be defined along with regime shifts and, analyses the links between schemes and the necessity of protecting a niche to ensure transferability of technology.

SNM scholars argue that for many innovations, user demand is not readily available because the innovations are not minor variations from the prevailing set of technologies but differ radically from them. Due to this, it is important to use real-world experimental projects as important devices that precede market niche development (Schot and Geels, 2008).

7.2.1 Application of SNM

In this section, the importance of creating a niche that can be used to protect sustainable innovations is presented. Using a niche to create space for innovations aids the transition that is necessary for the niche to be adapted and become a part of the overall landscape. The aspects of the current landscape, regime, and niche level are presented, along with the way they should be shaped for this innovation to be accepted. There will also be an attempt to utilise the identified aspects of technology to guide the analysis.

Landscape-level (Macro)

It is acknowledged that the landscape level is structured and difficult to change as it holds deep cultural patterns, macroeconomics, and political developments that make up the environment. Currently, the cultural patterns that exist are the informal structures of reuse that are not all referred to as recycling or resource reuse. Reuse and recycling in the Nigerian context are done more for cost-benefit. Although there is a shift of this idea in some demographics, it is still embedded in the culture as people tend to reuse or repair. The prevalence of reuse and repair has also made its way into the landscape as it is incorporated in many business models, including the Returnable Glass Bottle process.

For the idea of RGB to be transferred to a regime and landscape shift, there are changes that need to exist that will lead to or pave the way for implementation. In the case of implementing and embedding these changes, a shift towards sustainable waste management must occur. An example of this is to implement circular economy as a norm that is understood as beneficial in multiple ways. A continuous push of the idea of waste as a resource and ideas such as “waste to riches’ could cause a change to the landscape. The current discourse around resource and environmental management are beginning to make changes to the landscape and this continuous pressure can and will instigate change to the regime.

In addition to the changes to the cultural patterns that are necessary, there is also a need to explain and discover the shared value that this may provide to corporate entities and society. This can be seen in the way glass is reused with existential and environmental benefits.

In the micropolitical realms, the agenda must move away from the erroneous belief that the government is solely responsible for waste management and better environmental practice to an understanding that everybody is responsible for waste management.

There are currently pressures and agendas that are moving in a direction that allows for changes in the landscape. These include the move towards the use of extended producer responsibility (EPR) plans and the introduction of the standard for Recyclable Polyethene Terephthalate (RPET).

For this project, it can be argued that as the Returnable Glass Bottle (RGB) process is a scheme that already exists, there is not much change that needs to be done to the landscape to introduce this agenda for plastics.

Regime level (Meso)

The reuse of plastic bottles and the application of this on this level needs to be implemented as a cognitive routine. The general idea (to the majority of society) and practice is that plastic bottles, unlike glass, do not have inherent value to the producers or retailers (whoever is above them in the value chain). Implementing plastic reuse into business models and the idea of and practice that plastics should be better used or returned will be a regime shift. Success occurs for ideas and innovations after they are nurtured and embedded into the regime stage. To apply a similar scheme with plastic, the industry (beverage companies and plastic producers) needs to place a value on plastic bottles and the return of them for reuse, as has been done with glass.

The science aspect includes the experimentation with plastic to make it available for refill and reuse. Experimentation will need to include durability, reaction to beverage liquids, hygiene, health risks, and recyclability.

No policy or rule governs the reuse of glass. It is more of an organisational practice and business model. Due to the existence of this model, industries have standards that are in place to ensure that this process is done safely. For maximum benefits with plastic and an all encompassed solution, the implementation of policy or the integration of this idea into policy could further help to create a successful technological innovation.

Niche Level (Micro)

The goal of SNM is to create a space for novelties to emerge to eventually be integrated into the regime and then form a part of the landscape. In this case, the novelty is the product of reusable plastic bottles.

The FBRA (Food and Beverage Recycling Alliance) serves as an example of this steering from within. The group includes multiple partners that play a major role in setting a standard of voluntary practices that improve the disposal and recovery of plastics in Nigeria. The FBRA's interest in this agenda hinges on their role as creators of plastic waste. By working in this space, they can steer the niche in a way that directly affects them.

SNM calls for the creation of niches with the goal being to "develop ways of coping with the policy challenge of nurturing sustainable innovation journeys and transitions" (Schot and Geels, 2008). The FBRA exemplifies how within a niche, sustainable ideas can be implemented by all actors, even those that are not governmental bodies. In the case of plastic beverage bottles, a similar niche would need to be created to test this novelty and steer the results, actors, and impact in the right direction.

Governments do not insert niches; instead, they are assumed to emerge through collective enactment. By adding new actors, specific learning processes or, a set of demonstration projects, a niche can be steered to address many parts of the process and evolve dynamics towards a desired path (Schot and Geels, 2008).

The FBRA again serves as an example here. In this case, the FBRA is a new actor as it is formed to tackle joint issues and serves as a responsible body in the FMCG (Fast-Moving Consumer Goods) industry. The alliance is a collective and the niche created is set to lead towards a desire path and achieve their goal of establishing world-class industry compliance on Nigeria's Extended Producer Responsibility (EPR) programme. The government present laws or regulations that are put into place on the landscape level and this creates a need for specific learning processes or projects that may redirect evolving dynamics towards a path. These smaller niches allow for the responses to the government agenda to be tested and experimented and ensure accurate responses.

For reusable plastic beverage bottles, there would also be a necessity to create this niche to elicit new actors and learning processes that allow for experimentation in a niche.

7.2.2 Niche Internal Processes

For the niche internal process to be successful, there is a belief that selective exposure can lead to the replacement of dominant technologies. Once replaced, the development formed will create a socio-technical regime that regulates the new technology. This bottom up process is characterised by novelties emerging in technological niches than overcome the market niche and replace the regime. There are three processes that are used to successfully allow for this to occur (Schot and Geels, 2008)..

These are:

> *"(1) The articulation of expectations and visions. Expectations are considered crucial for niche development because they provide direction to learning processes, attract attention, and legitimate (continuing) protection and nurturing.*
>
> *(2) The building of social networks. This process is important to create a constituency behind the new technology, facilitate interactions between relevant stakeholders, and provide the necessary resources (money, people, expertise).*
>
> *(3) Learning processes at multiple dimensions:*
> *(a) technical aspects and design specifications*
> *(b) market and user preferences*
> *(c) cultural and symbolic meaning*
> *(d) infrastructure and maintenance networks*
> *(e) industry and production networks*
> *(f) regulations and government policy*
> *(g) societal and environmental effects"*
>
> *(Schot and Geels, 2008).*

The objective of this research is not to displace but to establish a parallel technology of reusing glass and plastic bottles simultaneously in the landscape. This deviates from the replacement of the dominant technology proposed by Schot and Geels above. This deviation is valid as both glass and plastic exist simultaneously in the landscape and serve similar functions. However, the difference is that there is a returnable process for glass bottles, and this does not yet exist for plastic bottles.

In the creation of circular use for plastic beverage bottles, there should be expectations that come along with the creation of the niche. For this research, the expectation and vision is for the establishment of a returnable plastic bottle process that is integrated into beverage companies' business models.

Creating and engaging shareholders and a social network is important for all innovations. By ensuring that actors that work in the same space and have a similar agenda are a part of the network built to help to ensure diffusion of this innovation. Some examples of members of the network include the FBRA, SON, and NESREA. The agenda of creating circular economy and a response to EPR processes allow for the sharing of ideas and solutions. It is also important to keep all aspects of the value chain in mind as there are many interactors with the proposed technology and all must play their role. From the production to consumption, the reactions, and the way that this changes for each member of the value chain should be noted.

The successful development of niches was correlated with learning processes on multiple dimensions. These dimensions and how they apply to glass and reusable plastic bottles are presented below.

(a) technical aspects and design specifications
The technicalities (which correlate with the technology model "technique" aspects) can be handled in various ways. The same technique used for glass may not be relevant or possible with plastics. However, the ideas may be directly transferable as the goal of the technique is the same, the product differs and the details that make these differences are what need to be considered. The goal of each aspect of the technique can be transferred and viewed as a standards or ideas to be embedded and should be done reiteratively to ensure success.

(b) market and user preferences
Companies are aware that users will not purchase products that do not satisfy their needs. Therefore, any product produced should correlate with the current advantages that plastics present. The returnable plastic bottle process should also be simple and easy to navigate, and incentives should be included to simulate the desire to purchase the beverage and return the bottle.

(c) cultural and symbolic meaning
The culture has a natural inkling for recycling/reusing products, which is apparent with glass beverage bottles. However, there is a culture of throwaway associated with plastic bottles.

Another cultural norm is that glass beverage bottles particularly alcoholic beverages are generally enjoyed as part of social events or gatherings and not "on the go" which simplifies retrieval. In addition to that, beverages are primarily used to serve drinks that contain carbon

or have a brewing process that results in a liquid that does not taste or fare as well in plastic. There is a preference for beverages in glass and this has been ingrained in the minds of certain demographics.

(d) infrastructure and maintenance networks

The infrastructure here refers to the facilities and/ or structures that are necessary for the direct reuse of plastic beverage bottles to take place. There is also a need to maintain networks of people and tools to ensure the design is sustainable and can be continuously used with an infrastructure that reproduces the necessary results.

(e) industry and production networks

The process of creating reusable plastic would need to be revisited along with taking into account the technique, knowledge, organisation, and product to ensure that all aspects are altered accordingly.

(f) regulations and government policy

The government is currently implementing ideas and exploring options to integrate EPR plans to incentivise circular packaging and encourage companies to be responsible for their waste. Becoming a part of this initiative is currently voluntary. However, this could become regulation. There will also need to be standards that govern the process of reuse for plastic bottles.

(g) societal and environmental effects

The market would need to change how it views plastic and adapt usage accordingly. This would initially be a learned process; however, continuation of the regime would see a shift and move to it becoming a cognitive routine as it continues and is practised. This shift will also affect the four components of technology, especially the product. The environmental effect is to positively reduce the amount of plastic bottles that are disposed as waste.

7.2.3 Summary of Strategic Niche Management

The goal and one way in which a niche is regarded as successful is its ability to transform from a technological niche (which provides protection) into a market niche and eventually a regime shift (Schot and Geels, 2008). By becoming a part of a market niche, the reuse of plastic bottles will no longer be an innovation but instead, it will have a specific application in industry. The vision of this success comes after the niche is part of R&D and becomes a technological niche. Returnable plastic bottles in this scenario is the output and the product of the technology. The product would be returnable and reusable plastic bottles serving their functional use by remaining transportable and convenient. Specifically, in this case, the plastic bottles will be reused for the same purpose by the industry that originally places them into the market. Recycling and reuse of plastic for other purposes currently does take place but bottles are not reused or refilled by beverage companies.

7.3 Summary of Theory-based Analysis

The theories serve as a guide for the discussion on how the reuse of glass bottles for beverages can be applied or translated to plastic bottles. The technology concept highlights the *aspects of technology* and what would be necessary for the implementation of such. The *product* for plastic bottles would be a system that allows for plastic bottle reuse that relies on a *technique* that is embedded in physical ware and processes that make this possible. The *knowledge* entails an understanding of the science and how this would play logistically and would need to be coupled with the correct org-ware. The correct *organisation* would entail enlisting the appropriate individuals across the value chain that will be able to properly produce this process. The infusion is dependent on the 6 conditions highlighted in the infusion of technology section being met. For infusion, the technology goes through five phases - basic research, the development phase, the formation phase, the application phase and the consumption phase.

For *Strategic Niche Management,* the goal is to create a niche that allows for experimentation of an innovation. To ensure that this experimentation occurs properly, there is a need to protect the niche as the innovation moves from the niche to the regime and eventually to the landscape. For the niche to be successful, there must be expectation and visions, a social network to interact with, and learning processes that must occur.

By doing this and identifying the aspects of technology, this can lead to the phenomena being explored across all the levels necessary before being embedded into the landscape.

8. Discussion

During this research, there have been many questions and ideas that arose or that have been presented as thoughts, issues or general concepts to be explored as these could also have an impact on findings, application of ideas and concepts. It is acknowledged that dependent on the individual or case perspective, there could be several other questions or ideas explored. Those that have presented as pertinent are discussed below.

8.1 Is the RGB process a dying practice?

The returning glass bottles has been acknowledged by stakeholders and those who have been engaged during and before this research. It appears to be a generally understood and accepted cognitive routine amongst individuals. All stakeholders interviewed that were not associated with the beverage companies presented uncertainty regarding whether the returnable glass bottle model was still as widely practised. When this was discussed or brought up by the researcher, it was suggested that the demographic in urban areas were more likely to make purchases on the go or have the disposal income to forfeit glass bottle deposits if necessary. This also highlighted the increase in the use of plastic and possibly the preference for plastic by users.

From the brewery/plant perspective, there is a higher profit margin gained from glass bottle beverages than from PET beverages. One interviewee when asked if there were any plans to discontinue the scheme/model mentions that there was a time where it appeared to be declining but market demand changed and the cost implication and environmental awareness of impact has called for a continuation of the model (Interviewee D, 2020). The use of glass beverage bottles is cost-effective, and the returnable glass process is embedded in the structure used by businesses.

When questioned, one interviewee expressed that the PET lines ran less than the glass bottle lines. Regarding consumption of glass versus PET, the bar/grill owner mentioned in his interview that when crates of PET bottles are purchased, there is less of a demand for these product. It is mentioned that there appears to be a stigma around the taste and the symbolic meaning behind consuming beverages in glass versus plastic containers. In addition to that, NAFDAC, has placed a ban on alcoholic beverages being sold in PET bottles (Nigeria's regulator mulls ban on sachets, PET bottles as alcoholic packages, 2020). This will occur over the next five year and all submitted proposals for packaging of alcoholic beverages in PET bottles and sachets are being denied (Company C, 2020).

Although some consumers have a belief that this model is no longer as widely practised, it appears that the returnable glass process is thriving and the business model is one that will most likely continue to be used for years to come.

8.2 Is the RGB process formal or informal?

The use of the returnable glass bottle process by private companies and corporations is presented in this research. These companies have formalised systems of refunding, checking, and collecting deposits or collateral with their distributors. There are formal collection processes and agreements with glass manufacturers.

Although it is not (yet) a response to government legislation, government bodies are also involved in the process. Regulatory boards are enlisted to ensure standards for glass are met before these glass bottles are introduced into the market. From the plant/brewery perspective, this is a formal scheme.

It does appear that as the glass bottles move across the distribution channel, the process becomes less formal. In the Bar/grill owner interview, the interviewee mentions that that the collection of a deposit is often conducted based on their relationship patrons. It is expressed that if a consumer is known and trusted, they will most likely be asked for a smaller deposit amount or may not even be charged at all. The cost of damages and breakages is also bore by the owner if any glass bottles are broken in house as consumers are not asked to pay a deposit when dining in house. The interviewee also concedes that glass bottles are rarely broken. In the consumer interview, it was also acknowledged that when purchasing beverages, if no bottles were available for exchange, there was an understanding between both parties that bottles would be returned. This shows how the scheme takes a less formal route towards the lower end of the chain. The pricing for bottle deposit does however seem to stay consistent across the channel until it reaches the retailer.

To answer whether the system is formal or informal depends on what part of the process one is involved in. It can be acknowledged that the scheme is recognised by patrons throughout the value chain.

8.3 Does the RGB process constitute circular economy (CE)?

Regarding circularity, the concept of circular economy is based on the idea of keeping goods and products in a closed loop. Coupled with the waste and zero waste hierarchy, the goal after the refusal stage is to have products be reused for the same purpose. In an ideal scenario, the fewer resources employed for this reuse or preparation for reuse, the better. The system of glass bottle reuse is a more desirable approach to resource management as the product is reused continuously for the same process. Even after bottles are deemed unsuitable for reuse, their cullets are collected and sold to glass manufacturers who use this as a resource to create new bottles. This is circular as the product is reused continuously in the same product cycle.

In some cases, even though retailers may reject damaged or old bottles, these are also sold to or collected by scavengers. Due to the landscape and regime view of glass beverage bottles, most Nigerians see bottles as having monetary value. Bottles collected by scavengers are sold to offtakers or waste processors or recyclers who introduce the bottles back into the system by recycling them. Although this is less desirable than direct reuse, it still falls under a sustainable approach for waste and resource management.

The idea of a circular economy is typically carried out as a response to legislation. However, as the ultimate goal is to create systems that aim to view and design products in a regenerative manner, it can be argued that any means of achieving this is an example of circular economy. To strengthen the use of this business model and the application of this to PET bottles, implementing such models as response to an EPR plans or other governmental programs and manufacturing practises may prove beneficial.

8.4 Why not explore the implementation of foreign Technology?

With the use of reverse vending machines for plastic bottles in places such as Germany or Denmark, importing solutions from the global north and localising them is an option, however, this discussion focuses on and defends the use of currently existing local ideas as a model for new technology. This question can also be applied to the use of the CE model as it explores a European Union framework. Although this is true, the CE model is an outline that is being considered globally. The concept itself is not a Euro-centric idea as it takes point of departure in regenerative systems that are exemplified in nature globally. The use of it in policy however is based on a European Union framework. The idea is a concept that fits into all social settings and does not push a technological adaptation.

The theories selected in this research are rooted in the idea that many structures can be used to better handle waste and move towards more widespread, circular, consumption and production patterns. There is currently no 'one size fits all' method that can be adapted by all societies and their waste handling procedures. It is important to note "the ability of technological solutions to improve the way resources are used and recycled. Technology selection differs by context. Communities vary by geography, technical capacity, waste composition, and income level. Often, the best solution is neither the newest nor the most advanced technologically" (Kaza et al., 2018:121). Individuals and industry may see the increased use of technology globally as a solution to improve resource use, repair, and recycling rates, however, not all solutions will, or can fit into every society or culture. It is important to review and analyse the socio-technological approach to ensure that this is done accurately and embraces cultural and societal differences.

The notion here is to use the current system as a base to help implement changes and improvements by carefully selecting stakeholders for partnership. This method is to be used instead of imagining ideal systems, technologies, and solutions (especially those deployed in the global north) and reproducing this technology. As an analogy, one can compare plugging and playing technology to the inconvenience of using a giant compactor in the lanes of the old city in Dhaka, Bangladesh. Although this method is used for waste collection in Australia, it is not transferable and here, modernisation does not necessarily mean motorisation. Instead, the use of the local technology of Dhaka works for the context of waste collection in India and this same method, although quaint would likely not be suitable for Australia. A sustainable, affordable waste management system consists of a stable mixture of technologies and institutions, which function flexibly under a clear policy umbrella (UN-Habitat, 2010).

A better and more encouraging approach is to gather information and a good understanding of local conditions and utilising these to form the basis for choosing management strategies and technologies, questioning if approaches will be successful or if they will be a recipe for environmental and economic disaster (UN-Habitat, 2010). Instead of copying technical specifications from other markets, the goal is to use this understanding and apply or modify local systems based on what does work, does not work, and what could work.

From a technology model perspective, the ideas presented by UN-Habitat involve analysing the four aspects of technology: the product, knowledge, organisation and techniques as a

method to solving waste management issues and utilising on-ground knowledge or processes to push a circular approach to waste and resource management. The push to utilise all stakeholder's current knowledge, regime, and practise, allows for changes to be viewed from a holistic perspective. Changes in one aspect are guaranteed to affect other aspects of the project.

8.5 Conclusion on Discussions

The returnable glass bottle process used by breweries and plants in Nigeria is a business model that does not appear to be on the decline. This system is embedded into society and the companies' day to day business transactions and procedures. The system can be classified as circular as it does include circular ideals and the model focuses on reuse and ventures away from the linear model that finds many resources in landfills. The practise does contain many formal elements, however depending on where interaction takes place, the scheme can be seen as formal or informal. Due to such caveats, this further emphasises the necessity of using local practises and schemes as a base for creating models that lead to a reduction in material found in the waste streams. The attempts to use external technologies in all cases will not serve as a solution as all societies present varying idiosyncrasies that need to be accounted for. There should be stakeholder engagement to holistically view solutions and avoid plug and play of ideas.

9. Factors to Be Considered for Replication

To answer the research question,

> *"By exploring the returnable glass bottle process in Nigeria, what initial factors should be considered to replicate this circular business model to plastic bottles in the same market?"*

the expectations and visions of the niche, as suggested by SNM need to be articulated for the its agenda to attract attention, gain protection, and explore its learning processes. The vision here is to replicate the business model used for returnable glass bottles in Nigeria to plastic bottles. With an exact vision in place, the factors that need to be considered for the novelty to take place can be outlined and serve as a guide for future work.

These factors can serve as action steps for beverage companies to contemplate if interested in exploring circular business models for the reuse of plastic bottles. The technology concept and Strategic Niche Management work well together as both do not encourage technological pushes but rather focus on exogenous growth from within by identifying factors necessary for continued exploration of a possible solution.

Stakeholder Participation

For ultimate success beyond integration in the private sector, the government must be holistically involved and should engage a wide range of stakeholders in the decision-making (Oyebade and Olanrewaju, 2019). Building a social network around the innovation ensure interaction and build a constituency that is involved with and dedicated to the success of this idea (Schot and Geels, 2008). Stakeholder participation takes into consideration many social aspects of an innovation, their views across the value chain should be incorporated into the decisions made by beverage companies when considering the application of this business model for plastic bottles. In addition to the knowledge aspect of technology, stakeholder participation also includes addressing the cultural and symbolic meaning attached to the use of and responses to products.

In the technology concept, those who make up the org-ware can be constitute the sociological factors. The org-ware consists of the division of labour central to organisations structure (Muller, 2010). This consists of the participants involved in the successful implementation of returnable plastics throughout the value chain. These stakeholders include plastic and bottle manufacturers that can deliver resources that can aid in the successful implementation of this scheme. Regarding consumers, in this case, these are referred to as those who purchase this product from the beverage company and all subsequent transaction until the final consumer is reached. For this to be carefully considered, the knowledge aspect must be tailored in a beneficial manner that can be implemented and understood by all users. The preferences of all users should be accounted for as their participation is imperative for the technology to succeed.

The cultural and symbolic attachments to the reuse of plastic bottle accompanied by the relevant narrative necessary to accompany the return and reuse of plastic should be fostered to create a niche and set the stage for acceptance by customers. By exploring and imploring

cognitive routine associated with the disposal of plastic, solutions can be devised to solve the problems created by plastic pollution.

Regulatory factors

The Returnable Glass Bottle (RGB) process is not employed as a response to regulation. However, this does not prohibit the application of this model with plastic bottles from being implemented as a response to regulations. The current discourse appeals for better resource use by suggesting circular economy as a means for elongating product life cycles. It also pushes a narrative that veers away from single-use plastic and requests for better options for disposable. The introduction of extended producer responsibility plans requires corporations to consider their products life cycle. NESREA has an EPR framework in place in Nigeria. Imbibing returnable plastic and reuse could serve as a response to this. By using returnable plastic and reusing this resource, the product becomes a company asset and the entire life cycle is accounted for.

In addition to the legislation guiding the process, one must also consider the legislation necessary to properly utilise the product and ensure that all health and safety requirements are adhered to. Standards similar to those implemented with glass will need to be established. For the establishment of these standards and regulations, there is a need to incorporate social networks and partnerships with organisations such as SON, NESREA, NAFDAC and any other regulatory boards that have a stake in the introduction of this product into the market. If policy is applied, this could be accompanied by the implementation of sanctions for non-compliant parties. SNM calls for selective exposure of technologies to the market to shape its use and production (Schot and Geels, 2008). Therefore, discussing and considering these are important aspects for shifting the technological niche to becoming a market niche.

Economic Factors

The motivation for the RGB process is cost savings and this aligns with the goal of businesses being to seek economic gain and make a profit. It is important to access the economic factors impacted across the value chain. The implementation of returnable plastic bottles should be cost beneficial to ensure the infusion of the technology into company protocol. The funding and initial start-up cost when acquiring infrastructure and should ideally be cost beneficial to the company to reuse this returnable plastic. A scheme that is not cost-beneficial is not sustainable for the business and will not have a lasting impact to serve as motivation for companies to implement or continue a process. Cost benefit can apply if there are sanctions for non-compliance that are more costly for the business than the implementation of a solution. The cost-benefit should also be apparent from a market user or consumer perspective as an affordable product.

Technological factors

Focusing on the technique necessary to implement returnable plastic bottles involves assessing the technical aspects and design specifications necessary for success. The product – returnable plastic bottles has a goal to serve as a response to plastic waste. To further this development the technology should address the product's goal. This can also be used in the exploration of a formula for the plastic used to create these bottles. The design specifications should address the current functions of plastic bottles while also incorporating the necessary aspects that will

allow for its reuse. A collaboration between SON and the beverage company can be explored to ensure food and safety regulations are met. This also encourages partnership with other stakeholders and interacts with other niches imploring current solutions and supporting experimentation.

The correct infrastructure needs to be in place across the value chain for this technology to be effective. There should also be a structure in place that considers maintenance networks. Regarding the aspects of technology, to ensure success, the organisation and knowledge aspect need to have the understanding to ensure proper use of equipment.

Environmental Factors

The goal of this innovation is to provide a sustainable response to the overwhelming issue of plastic pollution. The solution should be measured against its overall effect on the environment and this should be compared to the impact of the current regime. The mitigation of a problem should have a positive solution and not simply serve as an alternative approach. This can be done by assessing all environmental factors such as resource use, effects of sourcing such materials, energy used, and life cycles of products. This can be accomplished by conducting a life cycle assessment to ensure that the implementation of reuse correctly addresses the issue as opposed to causing subsequent problems.

Summary of Factors to Be Considered for Replication

Many of the factors to consider for replication of this process to plastics intertwine as stakeholders are involved in social networks, legislation, economics, and the technology. By considering the factors presented while in the niche stage, some of the pressures that may be presented in the landscape will be addressed before the innovation makes it into a market niche.

10. Conclusion

Plastic waste and plastic bottles continue to pose a threat to society as it is found in waste streams where many of these potential resources cause harm in a variety of ways such as blocking drainages which leads to flood, or by creating microplastics when found in the ocean. The goal of this research is to provide a solution to this local (and global issue) by looking at current practice in Nigeria. Plastic packaging is collected for reuse on various scales informally. However, these efforts are now being combined with those of the formal sector.

A snapshot is taken from Lagos as LAWMA's waste composition indicates that plastic makes up 23% of waste while glass and beverage containers only make up 2% of the waste collected. There is a possibility that this is due to factors such as the formal and informal sector's collection of glass and the Returnable Glass Bottle process used by beverage companies. By interviewing beverage companies, it became apparent that this age-old business model is used primarily for its cost benefit. However, this practise also hails as a circular business practice as it contains elements of product reuse and designs out single use which exacerbates landfill waste. This exploration led to the identification of the aspects that make up this technology serving as a guide to identify what is necessary for this technology's success. By viewing these aspects, an investigation is done to see what factors need to be considered for a similar approach with plastics.

The theory of Strategic Niche Management suggests that a niche needs to be created to nurture sustainable innovations and allow for experimentation and protection that will lead to greater success during the technology's infusion. The technology, environmental, economic and regulatory factors along with stakeholder participation need to be considered for successful replication.

It is believed that although more work will need to be done to effectively implement a similar system, by utilising a known system, there is a likelihood for success as there is no need to further localise ideas or adjust social settings. Successful development and exploration of the factors necessary for reuse of plastic bottles in a returnable bottle system used in a circular business model could serve as a solution to plastic pollution in Nigeria.

11. Future works

Moving on from this research, the goal is to implement tangible solutions that serve as answers based on the factors to be considered. This serves as future work as this is outside of the limitations of this research.

For technology, one may look further into the current realms of plastic reuse and recycling. Empty Bottle Inspection (EBI) machines for PET bottles do currently exist. As the EBI serves as an essential part of the technique for glass, the same will likely apply for returnable plastic bottles. By exploring the current technology available and considering these factors, solutions can be found for the technology factor. Although this research encourages endogenous growth, it is still important to gather exogenous knowledge and have an idea of what exists in the global landscape to attain best practise.

Regarding stakeholder participation, it is suggested that workshops and focus groups be held to further discover the socio-technical aspects that will allow for countrywide plastic reuse. These workshops and focus groups should include stakeholders from all aspects of the value chain including the company's internal networks.

For regulations, work with the FBRA and NESREA could also serve to provide a means for this idea to be embedded into legislation or encouraged as a solution. As the use of RPET is currently also its niche phase, collaboration could be done to explore partnering and incorporating this idea into the plastic regime. Doing so will also serve to eliminate the need to revisit this post introduction of RPET.

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Appendix (i)

Bar/Grill Owner Interview Guide

This interview is to gather an understanding of how retailers along the value chain handle glass. The goal being to understand how the returnable glass scheme actualises in bars and restaurants before and after the final consumer purchases the product. The purpose of this interview is to gather information on why this scheme is used, how this scheme works, its effectiveness and how success is measured. The interview will end with the interviewee asking for recommendations on other stakeholders that the interviewer believes may be able to supply further or interesting insights.

Questions

1. Could you please give me a bit of background and an understanding of the type of establishment you own or run?
2. What type of beverages do you sale?
3. Could you please explain how you started and how you purchase beverages from beverage companies, please emphasise any difference between brands.
4. Do you know how long this scheme has been practised?
    a. In that time, do you know if/ how things have changed? Is the practise losing popularity?
5. Can you explain what happens when you give bottles to and collect bottles from consumers.
6. Do your consumers take bottles off site and if so, is the process different?
7. How does the return of reusable bottles to the plants or breweries work?
8. What is the average cost of a bottle or bottle deposit?
9. Are there industry-wide standards or protocols for glass bottles (and recycling them)? (or does that vary from company to company?)
10. Is there a law or any regulations that guide the reuse of glass or any other waste?
11. What other waste do you produce? How do you manage that and is any recycled?
    a. Do you know about the Blue box initiative?
12. How does your establishment's waste management work? (Please provide information on who, where, how, etc)
13. Do you have any specific interaction with consumers about bottle reuse?
    a. Do you have to educate them or is this practice understood and known?
14. When do you recall the introduction of PET bottles for beverages?
15. What differences do you see with the introduction of plastic as an option?
    a. Has that made any changes to the way you conduct business?
16. Is there a trend with consumers and their preferences?
17. Do you think a similar scheme could be used for plastics or something to ensure more circularity?
    1. Do you think it is a good idea? What would be a reasonable amount for a plastic deposit?
    2. What would need to be in place for this to happen?
18. Looking at the perceived successes in the returnable glass bottle system? What are your thoughts on implementing similar systems or integrating these players into the future of recycling in Nigeria?
    a. What aspects and, actors, knowledge, tools and technology are important to keep in mind if a system must be implemented? What challenges do you think may appear as you move toward a standard for RPET?

Beverage company Interview Guide

The purpose of this interview is to gather qualitative and quantitative information about bottle reuse schemes, the reason for use, how this scheme works, its effectiveness and how that is measured.

From my understanding, glass bottles are collected from consumers (and retailers) and returned to companies for reuse, could you please clarify this and tell me more about the process (including how and why the bottles are collected and what they are used for)? Depending on the respondents' answer to the above, the following questions will also be asked.

Questions

1. What is the glass bottle handling scheme that your company uses?
2. What is the benefit of and why is there a glass reuse scheme? What is the motivation for recycling glass beverage bottles? Are/were there any laws or regulations that pushed for this in the past?
3. How does it take place across the value chain (in the brewery and on the field)? - Has it changed over the years and if so, how has it changed?
4. Are your bottles only collected in bulk from vendors (etc) or is there a way for consumers to hand in individual bottles? (This is assuming they are collected in bulk, if not, please explain the collection process)
5. Do you know how long this scheme has been practised? - In that time, do you know if/ how things have changed? Is the practise losing popularity?
6. Is there an industry-wide standard or protocol for glass bottles (and recycling them)? (or does that vary from company to company?)
7. Do you provide any specifications for your bottles to producers?
8. Does glass bottle recycling exist in every state and is it the same across the country?
9. What happens to broken or damaged glass bottles?
10. How many bottles on average are produced to sell? (please provide this figure or an estimate along with a period)
11. How many glass bottles are purchased (from producers)? And how often is this done?
12. How much value does the average glass bottle have? (new vs recycled)
13. What is the return rate of glass bottles?
14. How many times is one bottle recycled/reused?

General Packaging Questions

1. How do you think recycling/return numbers of bottles can be improved?
2. What is the difference between your glass and plastic practise? (Including production numbers, if possible)
3. Who do you think should be/is responsible for waste handling/recycling in general?
4. Are your packaging design responses to consumer practice or do consumers respond to what is provided?
5. What do you do to get the right information out to consumers regarding the post-consumer practice? (e.g. in this case, how to use the glass bottle recycling/deposit scheme?)
6. Do you think a similar idea or scheme could be done with plastics? Why or why not and what would need to be in place for it to happen?
7. Do you partner with waste facilities/handlers to ensure proper post-consumer waste practice?
8. Are there any other people that you recommend that I speak with (and why)?
9. Is there anything else you would like to mention that may aid this research? (Regarding human attitude, general practise etc)
10. Do you have suggestions on stakeholders or anyone who I should speak to to aid my research and findings?

Brewery Distribution Manager Interview Guide

The purpose of this interview is to gather qualitative and quantitative information about bottle reuse schemes, the reason for use, how this scheme works, its effectiveness and how that is measured.

Qualitative Questions

I have an understanding of the reusable glass bottle scheme, could you please clarify the following for me.

Depending on the respondents' answer to the above, the following questions will also be asked.

1. What is the benefit of and why is there a glass reuse scheme? What is the motivation for recycling glass beverage bottles? Are/were there any laws or regulations that pushed for this in the past?

2. How does it take place across the value chain (in the brewery and on the field)?
    - Has it changed over the years and if so, how has it changed?

3. Is there a minimum number of bottles that must be brought to you for collection?
    a. Are your bottles only collected in bulk from vendors (etc) or is there a way for consumers to hand in individual bottles? (This is assuming they are collected in bulk, if not, please explain the collection process)

4. Do you know how long this scheme has been practised?
    a. In that time, do you know if/ how things have changed?
    b. Is the practise losing popularity?
    c. Are there up and down seasons?

5. Is there an industry-wide standard or protocol for glass bottles (and recycling them)? (or does that vary from company to company?)

6. Do you provide any specifications for your bottles to producers?

7. Does glass bottle recycling exist in every state and is it the same across the country?

8. What happens to broken or damaged glass bottles?

Quantitative

1. How much value does the average glass bottle have? (new vs recycled)
2. What is the return rate of glass bottles?
3. How many times is one bottle recycled/reused?

General Packaging Questions

1. How do you think recycling/return of bottles can be improved?
2. What is the difference between your glass and plastic practise? (Including production numbers, if possible)
3. Who do you think should be/is responsible for waste handling/recycling in general?
4. Is your process/ are your packaging design responses to consumer practice or do consumers respond to what is provided?
5. What do you do to get the right information out to consumers/wholesalers/retailers regarding their and post-consumer practice? (e.g. in this case, how to use the glass bottle recycling/deposit scheme?)
6. Do you think a similar idea or scheme could be done with plastics? Why or why not and what would need to be in place for it to happen?
7. Are there any other people that you recommend that I speak with (and why)?
8. Is there anything else you would like to mention that may aid this research? (Regarding human attitude, general practise etc)
9. Do you have suggestions on stakeholders or anyone who I should speak to to aid my research and findings?

Consumer Interview Guide

1. What do you currently do with your waste? (Reusable and non-reusable)
2. Do you recycle at home? Have you ever?
3. If not, why?
4. Would you recycle if you had the option? Or, what would incentivise you to do so
5. What do you currently do with your waste?
6. If a similar scheme to glass bottle deposits was applied to plastic bottles, would this discourage you from purchasing goods in plastic?
7. What would be a reasonable amount for a plastic deposit?
8. What changes have you seen in waste management in Lagos?
9. What are your thoughts on or attitude towards littering?
10. What do you define as reusable waste?
11. Why the preference? (plastic or glass depending on the answer)
12. What issues do you currently have with LAWMA, etc?
13. Before LAWMA, how did you dispose of your waste and
14. What do you think are some of the effects of this system?
15. Advantages/disadvantages to the present and former system?

FBRA Interview Guide

This interview is to gather an understanding of the FBRAs goal to move towards a standard for RPET. I would also like to gain knowledge on current practise and also what is being looked into to ensure the implementation of a new system takes into account the current system in place and the way that implementing a new scheme requires strategic niche management.
The purpose of this interview is to gather information on why this scheme is used, how this scheme works, its effectiveness and how that is measured. The interview will end with the interviewee asking for recommendations on other stakeholders that the interviewer believes may be able to supply further or interesting insights.

Questions

Who is the FBRA and what do they do, could you please provide information on that, their motivation, how it all works and what the end goal and whether this plan/idea focus on the whole of Nigeria or is it just a couple of states?

Depending on the respondents' answer to the above, the following questions will also be asked.

1. What is the long-term goal that the FBRA would like to achieve? Could you speak a bit about the FBRA is coming up with a standard for RPET?

2. What is the current state of recycling in Nigeria? (Prompt about glass/plastic, if necessary)

3. Do you know much about or does the FBRA deal with the recycling/reuse of glass currently? Are there industry-wide standards or protocols for glass bottles (and recycling them)? (or does that vary from company to company?)

4. Do you know how long this scheme has been practised?
    a. In that time, do you know if/ how things have changed? Is the practise losing popularity?

5. Why is this approach being sought, what is currently wrong or what improvements need to be made to the current regime?

6. Are there any correlations with circular economy principles? Or even the SDGs for sustainable consumption and production?

7. Does your current plan consider the various actors/stakeholders already playing a role in recycling in Nigeria? (Who are they and what is their role?) and do you think anyone is missing?

8. What aspects and, actors, knowledge, tools and technology are important to keep in mind as you work towards this uniform standard and ensure that it is successful? Anything on policy? - You did not mention consumers or the informal sector, is there a reason for that?

9. What challenges do you think may appear as you move toward a standard for RPET?

10. What are you expecting from the others member of the alliance? Do you think this could trickle down to non-members?

11. Looking at the perceived successes in the informal sector and the use of glass beverage bottle recycling in Nigeria, what are your thoughts on implementing similar systems or integrating these players into the future plans of recycling in Nigeria? (FBRAs for plastic bottles and other packaging used for fast-moving consumer goods?)

Formal Recycler Interview Guide

The purpose of this interview is to gather qualitative and quantitative information about glass recycling in Nigeria. The goal is to understand why and how this reuse scheme works. Also, to gather knowledge on the effectiveness of glass bottle recycling and how that is measured. The interview will end with the interviewer asking for recommendations on other stakeholders that the interviewer believes may be able to provide further or interesting insights.

Qualitative Questions

Please explain what exactly you do and give some background on how you (and businesses like you) play a role in Nigeria's waste and resource management.

Depending on the respondents' answer to the above, the following questions will also be asked.

1. Are the specifics to the glass your company manages? If so, why?
2. How is bottles / glass collection done?
3. What is the benefit of and why do you recycle glass?
4. Do you know anything about glass bottle recycling on the beverage level?
5. What place does your glass bottle recycling hold across the value chain?
6. Do you know any history about glass bottle recycling in Nigeria? And what do you think the future of that looks like?
7. Do you know how long this scheme has been practised?
    - In that time, do you know if/ how things have changed? Is the practise losing popularity?
8. Is there an industry-wide standards or protocols for glass bottles (and recycling them)? (or does that vary from company to company?)
9. Do you provide any specifications for your bottles to producers? And is that required from you?
10. Does glass recycling exist in every state and is it the same across the country?

Quantitative

1. How much glass on average do you recycle? (please provide this figure or an estimate along with a period)
2. How much value does the average glass bottle have? (new vs recycled) And how is that accessed eg weight…?
3. How many glass bottles are purchased (from producers)? And how often is this done?
4. What is the return rate of glass bottles?
5. How many times is glass recycled?

General Packaging Questions

1. How do you think recycling/return on glass can be improved?
2. Who do you think should be/is responsible for waste handling/recycling in general?
3. Is your glass recycling a response to consumer practice or do consumers respond to what is provided?
4. What do you do to get the right information out to consumers regarding glass recycling? (e.g. in this case, how to use the glass bottle recycling/deposit scheme?)
5. Do you partner with waste facilities/handlers to ensure proper post-consumer waste practice?
6. What do you think Nigeria needs to look like to better facility recycling? What motivates Nigerians to recycle?
7. Do you think the approach/responses to glass can be applied to other resource fractions? (eg plastic)
8. Are there any other people that you recommend that I speak with (and why)?
9. Is there anything else you would like to mention that may aid this research? (Regarding human attitude, general practise etc)

LAWMA Interview Guide

Could you please give me a bit of a background about LAWMA, what they do and how they do it and anything to do with their recycling and CE approach? Depending on how this question is answered, the following questions will be asked.

Questions

1. How has waste collection changed over the years in Lagos?
2. What current strategy are you using for waste handling in Lagos?
3. What issues do you see with the current waste handling process in Lagos?
4. How effective has the introduced recycling scheme been so far?
5. What do you think needs to be focused on or changed to have more effective waste/recycling schemes in Lagos?
6. Are there any current waste trends (i.e. seasonal, etc)?
7. How do local and the former waste management type fit into the current scheme/system? (if it does)
8. What have been some of the effects/difference to Lagos' waste system since the launch of LAWMA?
9. Do you do any work with producers regarding getting a better understanding of their production processes and how to combat that? Or their ERPs, etc.
10. Do you do any work with aggregators, local/small businesses, and individuals?
11. What are some of the challenges that LAWMA faces with their waste management system?
12. What are some of the major factors that are posing a threat to LAWMAs waste system?

WeCyclers Interview Guide

The purpose of this interview is to gather qualitative and quantitative information about bottle waste reuse. Including how the system works the reason for doing so, its effectiveness and, how that is measured. The interview will end with the interviewer asking for recommendations on other stakeholders that the interviewee believes may be able to provide further or interesting insights.

Please tell me about what you and WeCyclers do including the history, why you do so, pros and cons of the business and what you hope for the future.

Qualitative

1. What waste items or fractions do you buy?
2. What items are in the highest demand and lowest demand?
3. Do all your products get sold or reused? What happens if they are not?
4. Please describe who your sellers consist of (i.e. demographic, socioeconomic status, etc)
5. Do sellers tend to use you as a primary or supplementary source of income?
6. How does your practice or service differ from an Onígò or kólẹ kólẹ? And how do you interact with them? (your general thoughts about this space).
7. What do you do with purchased items?
8. Is waste collected from the roadside, gutters, etc or are individuals collecting waste straight from the consumers?
9. What common mistakes do people make when attempting to sell items?
10. Do you work with any large enterprises or mainly individuals? (Please explain the process that you use)
11. The FBRA is working on an RPET standard, does this ease or add to your work?
12. What changes have been apparent (in the community) since you started the business?
13. Has there been a change in the availability of items that you purchase or are there any trends with items (e.g. time of year, the release of products, etc)?
14. If expansion was to be made, what differences do you believe you will encounter and how do you deal with that?
15. What would ease this process for you?
16. What do you think of Nigeria's response to waste handling, what are they doing well and what should they look to change?
17. Thoughts on consumers and citizens? (e.g., who do they think is/should responsible? What will change their thoughts or way of thinking?)

Quantitative

1. How much value do the items you purchase you have? Please provide a range with rough estimates.
2. How many sellers on average do you engage?
3. How many buyers do you engage?