

**THE UNIVERSITY OF THE WEST OF SCOTLAND (LONDON CAMPUS)**

**MBA IN LOGISTICS AND SUPPLY CHAIN MANAGEMENT – LNDN11133 – BUSINESS RESEARCH PROJECT 202223 T1**

# CHALLENGES AND OPPORTUNITIES OF ADOPTING CIRCULAR ECONOMY PRACTICES TO DESIGN SUSTAINABLE FOOD SUPPLY CHAIN IN NIGERIA

**By**

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 **Declaration**

I, [banner ID B00613259], the author of this dissertation, hereby declare that:

I have read and understood Regulations 3.49—3.55 of Chapter 3 of the Regulatory Framework of the University of the West of Scotland regarding cheating and plagiarism;

This assessment is the result of my own work, except for those parts that are
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**Acknowledgment**

Special thanks to my wife, Mrs. Uchenna Onwuachu for her support and for being by my side during this time. Without her, we could not have made this journey. Chimamanda Audrey, who would later understand and comprehend why her father was constantly working on his computer, deserves to be mentioned as well for her presence and inspiration. Thank you to my mother-in-law, Mrs. Ozemena Ibe, and my parents, Mr. and Mrs. Charles Onwuachu, for their unwavering encouragement, prayers, and faith. I want also to thank my sister Mrs. Queendarline A and in-law Mr. Akunebu for their tremendous help.

I want also to thank my lecturer and supervisor Dr. Md Mostain Belal for his encouragement and guidance throughout the stage of this research. I thank also all my lecturers throughout my journey at the University (UWS). My thank you to the University of the West of Scotland (London Campus) for the opportunity given to me to partake in this research MBA program. To all those who helped in the collection of data and information, I thank you all for the effect and help.

**Acronyms**

CE Circular Economy

LE Linear Economy

SC Supply Chain

FLW Food Loss & Waste

FSC Food Supply Chain

SFSC Sustainable Food Supply Chain

SDG Sustainable Development Goal

UNEP United Nations Environment Programme

SCP sustainable consumption and production

SCM supply chain management

ANP Analytical Network Process

GHG Greenhouse Gas

SFSCM Sustainable Food Supply Chain Management

ROI Return on investment

3Rs  Reducing waste, Reusing and Recycling resources

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# Abstract

To improve a sustainable productive, environmental-friendly, and organized supply chains, the food sector promotes the implementation of circular economy projects. Poor countries find it more difficult to adopt circular economies and sustainability-related principles than developed nations. SC activities is detrimental to people, environment and company continuity due to poor sustainability implementation. One out of three of yearly consumable food production is misplaced in the food supply chain processes. The economic, social and environmental impacts globally has recently received significant consideration by the practitioners, NGOs, government, politicians, economists and environmentalists. Though circular economy practices could significantly improve overall food sustainability, it is important to note the significant problems and prospects faced by the industry to adopt such practices. Therefore, this study will focus on investigating the problems and prospects associated with implementing CE-driven sustainable concepts in FSC in developing countries, notably Nigeria. To gather the data, semi-structured interviews with nine practitioners with a minimum of five years of professional experience in food industry were conducted using a purposive sampling strategy. The outcome points towards a weak government regulations/enforcement, stakeholders collaboration from supply chain actors, poor infrastructure, and absence of market preference/customer awareness as the major limitations. Moreso, lack of technology, poor infrastructure and poor government policies and implementation emerges as the most prominent barriers. In Nigeria, SC sustainability in food sector is still in its infancy and there is potential for development.

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# CHAPTER ONE

## 1.0 Introduction

The chapter addresses the factors that led to the research's interest in the opportunities and problems associated with using circular economy principles to create a sustainable FS chain in Nigeria. An outline of this research is then given, after which the research problems and concerns addressed in the study are further to formulate the key research questions.

## 1.1 Background of the Study

A network that links consumers, farmers, and manufacturers is known as a food supply chain (Antonucci et al, 2019). Agriculturalists, suppliers, wholesalers, storerooms, and traders, among others are working in the system of FSC with the aim of providing consumers with harmless, good and quality food (Dania et al, 2018). Many trashes ( food waste) are associated with the transformation of fresh food (produced by growers) to the food that is processed and its distribution to clients (Gardas et al, 2018). With regards to UNEP (2021), food that was wasted in the year 2019 globally was around nine hundred and thirty one million tonnes, and domestic was 61%, food services was 26% while commerce is 13 %, and for a total of 17% of edible food waste globally. From social, environmental, and economic perspectives, food waste has significant repercussions. After establishing the 3Rs, FSC waste disposal must discard the smallest quantity of trash in landfills with either reuse, recycle or recovery. Therefore, a closed-loop system in the FSC reduces waste. Thus, a circular concept increases the usage of generated food and lowers general food waste.

 Waste of food is linked to large emissions of greenhouse gases, damage to the environment, or disappearance of biological diversity, etc (Corrado et al., 2019), hence management of waste is essential (UNEP, 2021). Management of food waste is the greatest obstacle to maintainable growth due to inefficient food excess management (Ciccullo et al., 2021). In other to prevent food waste and loss, Papargyropoulou et al. (2014) present a sequence for the management of food waste, avoidance waste of food, reuse, recycling recovery, and throwing away. Though, there is a substantial space in the food supply chain for controlling food waste. According to Vilario et al. (2017), food loss and waste minimization are crucial components of recycling and reuse and contribute to the achievement of sustainable development objectives (SDGs). Therefore, the use of CE in the food supply is required to reduce, recycle and recover waste. The CE notion is one such concept that has been used over time for food waste reduction in food supply chain (Kumar, Singh, and Kumar, 2021).

From a food supply chain viewpoint, circular economy (CE) has quickly become a strong driving factor behind SC sustainability in study and experimentation. Before the point of sale, the supply chain generates 75–90% of the carbon footprint of a typical food product (Tidy et al, 2016). The circular economy (CE) represents a new and enhanced sustainability limit for SC management (Nasir et al., 2017). Some global supply chain giants, like Apple, Coca-Cola, and Colgate-Palmolive, are embracing circular economy (CE) characteristics (Farooque et al., 2019). In a traditional supply chain, trash is promptly sent to garbage dump, while a CE aims for zero waste and little rubbish dump (Bressanelli et al., 2019). To effectively embrace CE practices in the food supply chain, businesses must recognize and overcome significant obstacles. CE adoption in FSC provides several benefits. It may maximize food value, decrease food waste, and eliminate land disposal. Therefore, the implementation of a CE in FSC is urgently needed to promote maintainable development goals such as sustainable consumption and production (SCP) and eradication of hunger.

CE implementation for sustainable development objectives has several benefits, but it still confronts hurdles and impediments in reality. By reusing, reprocessing, and recycling food items, the circular economy (CE) may minimize environmental impact and waste. Previous research and the United Nations Environment Programme (UNEP) (2021) indicated that FSC has great space for decreasing waste of food and that the CE plays a vital role in reducing waste and sustainable development. The World Bank estimates that 40 percent of all food produced in Nigeria is lost and that each year, Nigerians trash at least 189 kilogrammes of food, or a total of 37.9 million tonnes of food while the 2019 hunger rate in Nigeria was 14.60% out of a population of nearly 200million (Ripplesnigeria,2021).Consequently, this paper investigates the obstacles and potential of applying a circular economy strategy in constructing a sustainable supply chain for food in Nigeria.

The vast bulk of research on the use of the circular economy has neglected developing economies such as Nigeria in favour of developed and rising economies. Food waste is a crucial problem for companies in developing nations that produce food. According to a large body of research, several factors contribute to food loss, including inadequate facilities and transportation, a lack of cooling, inadequate market services, inadequate packing, inadequate storage, inadequate quality control, etc. (see Table 2.1). To address the problems of food loss and waste in value chains, organizations should employ circular economy-driven, sustainability-oriented methods.

## 1.2 Statement of Problem

The needs for the adoption of CE practices stem from the increasing population and unsustainable food supply chain that are been undermined mostly in developing countries like Nigeria. Today, humanity is facing serious environmental problems ranging from climate changes, soil degradation and loss of biodiversity, basically due to rapid and dynamic technological advancement and the linear economy model cannot deliver a sustainable and maximum use of natural resources as it is prone to food wastes and environmental deterioration (Ionescu, 2020; Hodgkins, 2020). Therefore, given the level of food insecurity in developing countries which is caused by various factors including lack of government and various stakeholders commitment in developing a road map for food production, it becomes imperative to adopt CE practices to achieve workable use of food resources and recycling of waste to promote and execute maintainable production and consumption.

Food waste is believed to constitute a considerable fraction of total production waste (Borrello, Lombardi, Pascucci, & Cembalo, 2016). Food and Agricultural Organization (FAO, 2011) projected that one out of three of the global edible food supply chain (about 1.3 billion tonnes) is lost. Consequently, increased food waste has become a concern for the world’s security and ecological governance, with important environmental, financial, and social consequences (Liu et al.,2021). In an exceptional issue on nature of CE, Nigeria's use of global resources and trash production constitute a significant danger to the global food sustainability (Mathews and Tan, 2016).

One out of six (35 million tonnes) of the total grain from Nigeria is lost each year during production, processing, and transportation due to substandard equipment, inadequate information and expertise, and logistics problems which are made worse by a disjointed system of agriculture production . (Liu et al., 2013; Cui and Shoemaker, 2018). Faced with these environmental and waste management limitations (Geng et al., 2013), the Nigerian government has undertaken several strategies, laws, and monetary measures to bolster its CE programme (Mathews & Tan, 2016). The circular economy practice provides a country with opportunities such as a large-scale, concentrated, and low-cost supply of food loss and waste feedstock, a consumer shift toward natural-based products, an increase in fertilizer supply to meet market demand, and the current trend of progressive advancement in energy-conversion technology to combat climate change.

Therefore, in both study and practice, CE has quickly emerged as a powerful factor supporting SC sustainability. (Genovese et al., 2017; Hobson, 2016; Nasir et al., 2017), presenting a fresh and advanced sustainability borderline in SC management . Existing literature refers to the integration of a CE into the SC as a circular supply chain (Farooque and Zhang, 2017). This well-known Gartner analysis asserts that the future of the supply chain is circular, not linear (Aronow et al., 2018). However, the adoption of a CE in the FS chain faces several obstacles, including low technological readiness and reliability in estimating material potentials in terms of quantity and quality, high logistics costs associated with the collection of materials, safety concerns and low customer acceptance that create a marketing challenge, stricter regulations on animal feed production, and geographically dispersed supply locations (Shoemaker, 2018). This research focuses on the issue that Nigeria with the highest population in Africa, and that food insecurity has left many households hungry. Therefore, the research indicates the necessity for a study addressing Nigeria's perspective on CE practices.Koberg et al. (2019) analyze the problems and possibilities associated with creating a circular economy in this research. A comprehensive analysis of sustainable SC management practices in worldwide SC for the growth of a viable food SC in Nigeria is necessary.

## 1.3 Rationale of the study

The available literature indicates that the field of maintainable SC management has been explored from a variety of viewpoints in different settings and has gained pace over the years (Koberg and Longoni, 2019). Further research is required for each unique location, especially undeveloped and growing countries due to their constraints, as noted above, and the urgency of today's environmental and social challenges. Additionally, in the age of globalization, concerns relating to the environment, the economy, and society affect not only one nation, but also the whole area and the entire globe (Koberg and Longoni, 2019).

 Contextual considerations are critical for the sustainability of FSC in the setting of food industry (Toussaint et al., 2021). The available research reveals that empirical studies focusing on the variables influencing sustainable food value chains in developing and emerging countries are few. One of the top producers of fresh food in the world, Nigeria's smallholder farmers is responsible for the majority of the country's agricultural output. After harvest, more than forty per cent of this fresh product is wasted, which results in a loss of revenue for smallholders of more than thirty per cent (Ripplesnigeria, 2021). Therefore, there is a need for a study that explores the challenges and opportunities of adopting circular economy practices in designing a sustainable food supply chain in Nigeria.

## 1.4 Objectives of the Study

The main objective of this study is to investigate the challenges and opportunities of adopting circular CE in designing sustainable food supply chains in Nigeria. The specific objectives of this study include to:

1. to explore the significance of sustainable food supply chain design in Nigeria
2. to investigate the key challenges of adopting circular economy practices in designing a sustainable food supply chain in Nigeria
3. to explore key opportunities for adopting circular economy practices in designing a sustainable food supply chain in Nigeria.

## 1.5 Research Questions

The following questions will be addressed by this study:

1. What are the key challenges of adopting the CE practice in designing a sustainable food SC?
2. What are the key opportunities for adopting the CE practice in designing a sustainable FSC?

.

## 1.6 Scope of the Study

This study focuses on investigating the challenges and opportunities in adopting the circular economy practice in designing a sustainable food supply chain in developing countries a case of the Nigerian food supply chain Market. Therefore, the study cover farmer, food supplier, and food processing firm in Nigeria. The study deploys literature review and interview techniques as the main approach to achieving the study objectives.

## 1.7 Organization of the Study

This research work is organized in five chapters. Chapter one covers the introduction which includes the background of the study, a statement of the problem, the objectives of the study, research questions, and the significance of the study. Chapter two concentrates on the literature review while chapter three emphasizes on the methodology and philosophy adopted in the study. Chapter four looks at analysis and discussion while chapter five summaries the findings, conclusion and recommendations.

**1.8 Chapter Summary**

In conclusion, this chapter provides a brief overview of the motivation, the research problem, and the importance of this research in recognizing the opportunities and limitations of adopting circular economy practices in designing a sustainable food supply chain in Nigeria. This chapter's goal is to explain the justifications behind the research questions, the setting of the study, and its significance. This also included a summary of the research organizational structure so that readers could easily move between its many chapters. The topic of the following chapter will be a review of the literature with a specific focus on the study's objectives and relevant research gaps.

#

# CHAPTER TWO

# LITERATURE REVIEW

## 2.1 Conceptual Review

This section concentrates on the review of the previous study on basic concepts and theories relevant to the study. The review adds to the writing by giving new bits of knowledge about the proceeding difficulties that SSC faces in emerging nations like Nigeria.

### 2.1.1 The Concept of Circular Economy

As a method of sustainable economics, CE lessens the extraction of raw materials and permits resource recirculation, resulting in favorable settings for both societies and industry (Ada et al,2021). However, putting CE into practice necessitates both radical alternative economic solutions and innovative resource management while resource utilization, waste, and emissions issues along the supply chain are the primary goals of CE (Ada et al, 2021). The take-make-waste linear economy is thought to be replaced by a circular economy (CE). CE operates under the tenets of preserving resources and renewing natural systems while minimizing waste and pollution and in this economic system, the concepts of end-of-life and reduce, reuse, recover, and recycle are used instead (Do, Q et al, 2022).

# 2.1.2 Circular Economy Practices

CE is defined through specific actions and practices such as eco-design, reuse, refurbishment, remanufacturing (e.g., Nasr and Thurston [2006](https://onlinelibrary.wiley.com/doi/full/10.1111/jiec.12732?casa_token=PH2JQ_37-r0AAAAA%3AXn-f208E8RwDEScwvK9f2lPpYLYMwThOfmcT_f1TjBLl1hgO1EqFE8aJfxpOiOuV2Xi3ZRTZP67DfhY#jiec12732-bib-0064)), repair, product sharing, and industrial symbiosis (IS) (Chertow and Ehrenfeld [2012](https://onlinelibrary.wiley.com/doi/full/10.1111/jiec.12732?casa_token=PH2JQ_37-r0AAAAA%3AXn-f208E8RwDEScwvK9f2lPpYLYMwThOfmcT_f1TjBLl1hgO1EqFE8aJfxpOiOuV2Xi3ZRTZP67DfhY#jiec12732-bib-0020)).

* **Recycling**

This is a process of disassembling discarded products into their constituent parts and turning them into new products. The raw materials in this instance would then only need to be extracted once, saving time, energy, and labour, and they would be continuously cycled and recycled. Raw resources must first be mined, processed into something more usable, and then put together into components, and eventually into goods, before they can be sold. When a product is thrown away at the end of its useful life, all the work and value that went into it are also lost. Every recycling method is an effort to keep some of the embodied value. According to Defra, 2008, a million tonnes of textiles are produced in the UK estimated to be valued £238 million yearly disposed of in landfills, which, given limited resources capacity of a landfill would occupy the available area suppose these numbers persist in ten years.

According to Kim and Kim 2016 findings, due to these challenges and the depletion of raw material the culture of throwaway clothing has slowly spread around the world especially in the UK , and the amount of textile waste generated as a result has increased the negative social, economic, and environmental repercussions. Reviewing the UK case for the textile recycling process, management demonstrates competence in the management of charitable organizations and recycling businesses for trash distribution and collection. As charities and recycling businesses run their operations in this kind of collaboration under government control and supervision, the waste collection and distribution channels are built in an efficient and effective process regarding the high recycling rates of the waste and social contribution from its sales and profit with over 380 members joining the charity companies with more than 7,800 outlets stores that resell donated used clothing to the population and the excess inventory sold to recycling companies (Kim and Kim, 2016). This minimizes the waste on the textile industries in the UK.

* **Reuse**

Reusing items or materials helps to lessen the environmental harm caused by pollution by keeping them from becoming waste. When waste is disposed of in landfills, it harms the ecosystem by lowering the quality of the air and water, as well as having an impact on the local species and biodiversity (Radhakrishnan 2016).

A review on the research of reuse of the waste water in Germany for irrigation on crop material according to Maab, and Grundmann (2018), observed that governance structure's alignment with irrigation's unique characteristics and the associations of farmers' interdependence with one another support the reuse program's efficient functioning. Pooling of resources with distinct ownership and decision-making powers characterizes the governance structure designed to match the irrigation's characteristics. Growing interest has been shown in the use of wastewater reuse in agriculture as a means of assisting the water and agricultural industries' transition to the circular economy in Gemany according to this study. Reusing wastewater gives a chance to lessen the demands on natural water resources and the discharge of pollutants to surface water bodies when done safely based on this review.

* **Remanufacturing**

Remanufacturing is a procedure where the used product goes through a series of procedures such disassembly, sorting and cleaning, scanning, refurbishing or replacement, reassembly, and quality testing before being put on the market and is a crucial part of the circular economy because it helps to extend the life cycle of goods that are no longer needed or in use, which helps to harness the advantages for the environment, the economy, and society (Singhal et al, 2020).

The United States is the largest remanufacturer in the world, producing remanufactured goods worth $43 billion and providing 180000 jobs while the largest remanufacturers in Europe are in Germany, the United Kingdom, the Netherlands, and France (USITC, 2012). There are environmental advantages, such as reduced energy and material consumption and carbon footprint in remanufacturing ([Wang et al., 2016](https://www.sciencedirect.com/science/article/pii/S0921344920300033?casa_token=hudFJ62UchAAAAAA:fB6xxd4sJ17U2IL_7qLV8INHAzkNBnKJNsR13ybL8cl1nq8U6OQHmBnDzvw1EUP0qZ-SkMpPSA#bib0525)). For instance, the energy needed to produce the same number of remanufactured products uses 85% less energy than the production of new products ([Hazen et al., 2017](https://www.sciencedirect.com/science/article/pii/S0921344920300033?casa_token=hudFJ62UchAAAAAA:fB6xxd4sJ17U2IL_7qLV8INHAzkNBnKJNsR13ybL8cl1nq8U6OQHmBnDzvw1EUP0qZ-SkMpPSA#bib0165)). Additionally, the remanufacturing of engines results in a decrease of 55 kg of steel and 565 kg of CO2 (Zhang et al., 2011). With the same amount of energy and materials used in manufacturing, 7–11 more units can be produced (Steinhilper, 2001). Remanufactured goods are typically sold for as little as 60% of the price of brand-new goods (Rathore et al., 2011)..

* **Reverse Logistics**

According to Guide and Van Wassenhove (2009), the movement of products from consumers back to manufacturers is referred to as reverse logistics which is one element of a CE and without reverse logistics, a product flow often ends with customers disposing of products in landfills. Returned merchandise from customers, product recalls, excess inventory, or just a product that has outlived its usefulness can all trigger the reverse logistics process.

According to Wilson et al (2022) findings is that although the numerous reverse logistics functions and duties each rely on a different type of Artificial intelligent which has considerable benefits across all functions and tasks in the process.

**2.1.3 Sustainable Food Supply Chain**

## Based on the UN Global Compact, the goal of supply chain sustainability is to "produce, protect, and grow long-term environmental, social, and economic value for all stakeholders involved in bringing goods and services to market. A food supply chain consists of the businesses in charge of producing and distributing goods made from either plants or animals. Food supply chains are distinct from those for other products. In reference to Figure 2.1, which consist of supplier, manufacturer, distribution, return and waste will be evaluated on the sustainable approach on food supply chain in there various activities

##

SUPPLIER

DISTRIBUTION

RETURN

MANUFACTURING

##

WASTE

## Figure 2.1 – Supply Chain Diagram - Source Researcher

 **Supplier**

In other to maintain sustainability of the supply to manufacturing Stage, Companies need evaluation to qualify suppliers as well as solve other issues like choosing, rating, categorizing, and/or sorting providers. Sorting and classification are two distinct issues in the multicriteria approach. According on Tidy et al (2016), greenhouse gas emissions are greatly impacted by the food supply chain. Tidy et al (2016) noted that in the food retailing industry in the United Kingdom (UK), supermarkets are the dominant players and responsible retailers must change supplier behaviour to lower emissions because 75–90% of the carbon footprint of a typical food product is created in the supply chain before the point of sale.

 **Manufacturing**

 According to estimates, the entire food system in developed countries produces between 15 and 28% of the total GHG emissions, with all supply chain phases from agricultural production to processing contributing to approximately half of the GHG emissions connected to food in developed nations and higher in upcoming economies with less advanced post-harvest supply chains (Smith et al, 2007). In other words, green food processing is vital to the sustenance of food production in the future. Green food processing is centered on the innovation of method that will utilize less water and energy, allow the recycling of waste products through bio-refineries, and provide food that is both safe and of a high standard (Chemat et al, 2017). Lack of technical know how, funding, infrastructure, government policies and collaboration of supply chain are some of the challenges in adopting green method on food processing especially in the developing nations ( See Table 2.1)

 **Distribution**

There are multiple activities involved in distribution, such as packaging and shipping, and this have a significant environmental impact. Carbon dioxide (CO2), a greenhouse gas that contributes to global warming, is reduced using sustainable distribution techniques (USEPA, 2022). Almost every firm is a contributor to ecological overrun and its occurs when the ecosystem's capacity to engage our carbon dioxide emissions and replace the resources we have depleted at a rate that keeps up with our consumption surpasses our collective demand on the ecosystem (Agility, 2021).

Green distribution methods put efficiency first to avoid wasting energy that could entail anything from more effective use of shipping containers or vehicles for packing to attaining the best fuel efficiency possible for ground transportation (Agility, 2021). All of it translates into huge energy savings and a decrease in carbon emissions. More importantly, though, a smoothly operating company typically has a happier staff, better customer outcomes, and fewer resources squandered. Consider this as a win-win situation for you and the environment since most organizations aim to increase operational effectiveness.

There are also lots of benefit economically. It goes without saying that using less energy will increase organization’s profits and the business might save a lot of money by making even very little adjustments, like remembering to turn off exterior floodlights during the day. For instance, a 2018 energy assessment by academics revealed that a Zimbabwean industrial site could save over $50,000 annually on electricity costs just by upgrading its lighting equipment (USEPA, 2022). When you take into account how sustainable distribution optimizes numerous processes throughout your supply chain, it's simple to see how quickly the savings can up from the business.

 **Waste**

Any city's zero waste strategy must include effective handling of food and organic waste. Food waste amounts to about 8% of the global Green House Gas (GHG) emissions and a third of the food produced worldwide is lost or wasted.

The appropriate use of biogas produced from waste can be promoted as a means of accomplishing the objective of sustainable renewable energy. The production of biogas is influenced by waste management for sustainability (Aziz and Hanafiah, 2020). Sustainable bioenergy can take the place of non-sustainable energy sources (Rincon et al., 2019). A need for alternate energy sources is favoured by increasing fuel consumption due to a growing population. Finding a viable renewable energy source that is environmentally sustainable is of global significance. To create bioenergy, waste water from the paper, pulp, and food sectors is used (Goud et al., 2014; Vaez and Zilouei, 2020).

400 million tonnes of paper are produced annually by the 5000 paper and pulp factories that exist worldwide and in other to address the effluent problem sustainably, biomethane and biohydrogen are created from the effluents of paper mills (Gottumukkala et al., 2016; Vaez and Zilouei, 2020).With the help of the anaerobic digestion (AD) process, the palm oil mill is one of the potential sources of organic waste that may be converted to biogas, thereby trapping the methane that can be used productively (Xu et al., 2019).Food waste is converted into bioenergy by biological processes such as aerobic composting, feed fermentation, AD, and bioethanol production (Kiran et al., 2014).

## 2.1.4 Key component of designing a sustainable Food Supply Chain

 Most of the early processes in the FC, like acquisition of material, manufacturing , and supply, and the reverse processes to gather and process, goods return or not used and/or parts of products, is known as as sustainable FSC management to achieve socioeconomically and environmentally sustainable recovery (Bloemhof and van Nunen 2008). Food consumption has greatly grown owing to population expansion, changes in nutritional requirements generally, and increasing income levels. The CE paradigm aims for sustainability by reversing environmental degradation and preserving the economic and social health of the present. The need for food production and delivery has grown due to this rise in consumption, creating serious global economic, societal, and environmental issues (Tilman et al. 2002). According to the Food and Agriculture Organization of the United Nations (FAO), food sectors must simultaneously boost productivity and reduce the negative effects of production and distribution (FAO 2012).

Any company must take into account the following components to develop a sustainable food supply chain, as shown in Figure 2.1. They consist of:

### Senior Leadership's Commitment:

Starting at the top of the firm, a corporate culture where environmental, sociological, and economic implications are given equal weight must be developed. Because the shift in business procedures and employee behaviour represents a major deviation from accepted norms, senior management involvement is necessary. Resistance to the necessary adjustments in methods, measures, and behaviours is nearly a given in any change management approach. For instance, our farmers' and input service providers' "get it done" mentality—often sensible given Mother Nature's time constraints—might need to adapt when taking into account considerations like employee safety, environmental effects from drift, runoff, volatilization, etc. Common fertiliser application procedures in the autumn may need to be balanced against their effects on water quality, and innovations may need to be developed to strike a balance between the need for fall application and the need to lessen the workload in the spring. Although these kinds of changes are difficult to implement, projects cannot succeed without the support of senior management (Bloemhof and van Nunen 2008).

### Engaging important Supply Chain Participants

Agriculture-related individuals and businesses have a reputation for being fiercely independent. Throughout the value chain, they have depended on free markets and arm's-length transactions. The food sector of the economy has likewise tended to stay out of agriculture and let markets decide how raw materials are exchanged for food products. Food and agribusiness firms throughout the chain must grow increasingly reliant on one another as demand for more sustainable food supply chains rises. To enable sustainable metrics to be monitored and traced across the system, players in sustainable food supply chains must cooperate, take responsibility for their activities, and exchange information transparently. The participants on the food supply chains in the developing nations like the farmers ,the food processing companies, the logistics companies and the distributors should engage each other in information sharing etc. in other to attain food supply chain sustainability. For instance according to Maab, and Grundmann (2018) research, the successful use of waste water for crop irrigation in Germany was due to government alignment with farmers associations which supports the reuse program's efficiently.

### Supply Chain Members Participating in the Strategy

 The players in the food and supply chains will need to collaborate to have significant sustainability benefits, and they will also need to be willing to publicly communicate how the chain's strategies are being developed and align those goals with their own companies. Due to misaligned incentives and/or pressure from individual actors to avoid responsibility, a sustainable food supply chain plan that is not in line with the objectives of the individual enterprises is likewise destined to fail. Chain and company strategy alignment is a collaborative effort. To enable chain players outside of the specific business to become more acquainted with and involved with the individual company's strategy, the alignment must be flexible and open. Hence, the success of the strategy's development will depend on the establishment of close bonds and trust among the supply chain's participants (Sadraei et al, 2022).

### Technical Capabilities Development

To fulfil consumer demands, the food and agriculture supply chain involves a tangled combination of hard sciences and social sciences, which may clash. Human talent must be able to comprehend, communicate, and act on this confluence of sciences in innovative ways as the chain adjusts to meet future sustainability needs. It is necessary to create talent with the ability to monitor and trace operations both inside and across organizations. It is also necessary to train personnel with the interpersonal skills necessary to forge bonds of trust and establish interdependencies among businesses so that sustainable food supply chain strategies may be implemented successfully. To continually increase the effects of sustainable food supply chain policies, people that can drive innovation must be created (Barua, 2022).

**Figure 2.2** Sustainable Supply Chain Design(Source – Author)

## 2.1.5 The Importance of Circular Economy Practice to achieve sustainability.

 FSC goods are designed for extensive recycling, restoration, reuse, and circular production. In addition, the collection of high-quality biological nutrients (e.g., organic materials) in this manner contributes directly or indirectly to natural resources (De Angelis et al., 2018). Several academics (Lehtokunnas et al., 2020) have already reduced significant amounts of garbage using CE methods, indicating a connection between the FSC and waste minimization.

Genovese et al. (2017) conducted a life cycle study and found that CE practices boost the FSC's sustainability and benefit the environment. Meherishi et al. (2019) found that sustainable packaging in supply chain management facilitates CE practices. Jurgilevich et al. (2016) examined the barriers to using the concept of CE in the FSC. Principato et al. (2019) offered a case study on CE processes in the pasta production industry. They found that pasta manufacturing is the most exemplary example of CE since it contributes to just 2% of food loss and waste across its whole life cycle. Given that almost 0.8 billion people globally suffer from chronic hunger and that the majority of developing countries score low on the hunger index, minimizing food waste is one of the food industry's most critical sustainability problems (FAO, 2014).

Packaging is considered a vital element of sustainable food consumption and a great way to reduce food waste by preserving food fit for human consumption and viably reducing carbon footprints as well (Guillard et al., 2018)

According to a statistic published in 2014, the world manufactured three hundred and eleven metric tons of plastic in a one year, using up 6% of the oil used for manufacturing plastic , only 5% of the total amount of plastic was recycled for later use, resulting in a loss in productivity of 26% by volume, or £62–92 billion and by 2050, it is predicted that annual plastic manufacturing would have increased to one hundred and twenty four metric tons, using 20% of the world's oil supply (World Economic Forum, 2016).

**Table 2.1** Literature Review Table on the aim, opportunities and Challenges of CE food supply chain

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **AUTHOR****/YEAR** | **METHODOLOGY** | **COUNTRY**  | **AIM OF THE STUDY**  | **KEY FINDING** | **KEY CHALLENGES**  | **KEY OPPORTUNITY** |
| Do et al (2021) | Mixed  | UK, Italy, |  Customer readiness in a Circular Economy  | Excessive food modification may pose a risk to the health of customers | 1. Low level of technological readiness
2. expensive collection-related logistics costs
3. Government policies and implimentation
 | 1. New commercial opportunities by industry practitioners
2. The abundant, focused, and inexpensive supply of FLW feedstock
 |
|  Ada et al (2021) | Qualitative 65%: Quantitative 25%,mixed 10%-  | EUROPEAN UNION  | Explore the barriers of Circular Economy in FSC | Industry 4.0 can help CE solve its issues.Tools for processing data on the blockchaincan deliver the transparency necessary for taxes and incentive systems, which is a key concern. | (1)Lack of knowledge and skills(2) Lack of blockchian Technology. access to resources for investments and infrastructure. (3)Weak regulations,  | Decreases the exploitation of raw materials and allows for resource recirculation. Creating products in accordance with customer specifications |
| Farooque, M et al (2019) | Qualitative: Quantitative  | CHINA  | to analyse causal-effect links in a methodical manner | lack of publiccommitment to and support for the government’s CEaspiration | lack of market preference or pressure.Weak environmental regulations and enforcement collaboration/support from supply chain actors. | possible collaboration opportunity with neighbouring businesses and also promotes the creation and upkeep of a formal regional eco-industrial network |
| Kumar et al(2022) | Qualitative | INDIA  | To investigate the difficulties of CE adoption in India | To have a profound understanding, it is necessary to analyse the indicated components. | Lack of Government policymaking and offering incentives. Strictly enforcing environmental regulations. | It is possible to engage in corporate social responsibility (CSR). |
| Sadraei et al (2022) | Qualitative: Quantitative & Mixed  | Italy , USA, UK , China Brazil Australia Spain Austria Turkey Malaysia | to investigate bibliometric factors relating to waste in the food business | Lots of Pollution caused by food production. To reduce food waste, businesses should adjust their circular business models and provide themselves with cutting-edge production facilities; Customers should demand from businesses waste reduction strategies and partnerships with organizations that distribute food to the underprivileged. More evidence should be provided regarding pollution. | Lack of technology. Lack of collaboration between supply chain. Cultural implications. Government regulations and enforcement  | Using effective collection methods, treated food waste can be used again. |
| Zhang et al(2021) | Qualitative, Quantitative/ Mixed  | EUROPEAN UNION | How to encourage participants at various levels of a food supply chain to follow sustainable practises | The key issue that needs to be how to successfully apply CE concepts to the management of the food supply chain, particularly CE-based food waste management. | Lack of policies and legislation enforcement- transition challenges.  | Eradication of poverty and hunger |
|  Suhartini et al (2021) | Mixed  | Indonesia | investigating the production of energy from food waste | processes pose a risk to the natural environment if not managed correctly | Low Technology  | The fuel for domestic cooking can be made from briquettes made from food waste. |
| Saurabh Ardra1 ; Mukesh Kumar Barua (2022) | Qualitative: Quantitative/ mixed  | INDIA | Identification of barriers/factors to implementing circular practices in the food supply chain | Government policy , Culture | Information mechanisms to monitor recycled goods are lacking.Lack of production technique. | The CE economic model seeks to maximise resource productivity while avoiding waste. |
| Zahir Irani and Amir M. Sharif (2017) | Qualitative | Italy | examine how strategic planning is used, used, and relevant in FSC | usage of strategic planning tools capable of comprehensively capturing a multitude of interrelated factors | the improper preparation, processing, storage, transportation, consumption, and disposal of food products | Food with the highest nutritional value, the least amount of trash, and no land-based disposal |
| Howard et al (2022) | Qualitative | UK  | Examine tools and techniques for small- to medium-sized businesses to adopt the circular economy. | Make production more efficient by maximising the value of the materials. | insufficient ambient culture or support system to facilitate the adoption of CE | Cost-cutting and its effect on the bottom line |
| Krishnan et al (2019) | Qualitative | India  | Intends to use environmental impact assessment to find operational and resource inefficiencies in FSC. | natural resource depletion hazardous gas emissions into the environment, energy usage drinking water | Low technology. Government policy | Lessen the number of virgin input resources needed throughout the FSC's cultivation stage. |
| Sadhukhan et al (2020) | Qualitative | India  | Examine the following global challenges for a sustainable 21st century: a plant-based diet, avoidable food waste, biorefining, and a circular economy. | Cultural issues, lack of collaboation | Technology.. Government policy | Zero hunger, zero poverty through biorefinery and bioeconomy; biosurfactant and chemical manufacturing from bioresources |
| Sharma et al (2019) | Mixed | India | Examining the different obstacles to the successful implementation of circular economy-led sustainability in FSC is the goal of the current investigation. | Poor government policies. Lack of tools and technology, and farmers' ignorance .Lack of understanding | .transportation and infrastructure caused by bad government policy. tractability problems Issues with packaging and a weak cold chain. Lack of farming knowledge and awareness, lower production, a lack of technology  | CE assist administrators and decision-makers in the efficient management of natural resources in the food industry |
| Sarker et al (2022) | Qualitative, Mixed  | Bangladish | study the difficulties of supplying sustainable food to China. | While FW is not managed separately, some typical waste management techniques are used. | Cultural issues, Givernment policies . Techonolgy | Conversion of waste to energy. Integrated Biorefinary. Waste to value added product  |
| Hamam et al (2021) | Qualitative | Australia  | Understanding its primary traits and viewpoints, as well as reviewing and debating the literature CE area.  | implementation of cleaner production methods, a corresponding rise in stakeholder accountability and consciousness on the part of both producers and consumers. implementation of suitable tools and regulations. | Lack of tight coordination amongst all parties involved. Government policies  | A promising approach to promoting regenerative, restorative, and sustainable agriculture  |
| Yoong et al (2021) | Quantitative  | Malaysia | Investigate how resource recovery from food waste might be useful. | Implementing resource recovery from food waste can make a direct or indirect contribution. | Changing the consumer buying behaviour; food consumption behaviour. Technology, Regulation policies  | Good health and wellbeing; absence of poverty;Sanitation and clean water; Cost-effective and clean energy, decent employment, and economic expansion; Healthy Communities and Cities |
| Taghavi, Fallahpour, Wong, and Hoseini (2021) | Quantitative  | Iran  | Aim to determine and rank the elements that affectthe GSCM's implementation | External factors  | Lack o government polices, Consumer and supplier’s behaviour  | reduce the negative environmental impact |
| Kayikci et al (2022) | Qualitative  | Holland  | Examines if blockchain technology is suitable for addressing significant issues in the food business, such as traceability, trust, and accountability. | Robust tools to be available in the Industry 4.0. Blockchain consortium are the widely accepted and appropriate models for use in business | Consumer’s behaviour. Lack of   transparency. expensive solution to implement. Capacity to trace lots backward and forward. | Developing the financial identities of smallholder farmers. Public safety, reducing fraud and transparency, and reining in financial waste |
| Al-Saidi et al (2021) | Qualitative | Qatar | Dissect the circular economy concept in the context of the water and food sectors, as well as other fundamental supply sectors. | utilising by-products of desalination,raising household engagement and understanding in waste management. promoting low-hanging fruit based on the reduction and reuse principles | Government polices and implementation  | Using treated wastewater as a different resource to produce food. Using both organic and inorganic substances, producing biomass as feedstock. Conversion and recycling of food waste is creating potential for capturing resources for biorefineries and renewable energy production. |
| Boon, E.K. and Anuga, S.W., (2020) | Qualitative | Ghana | The adopted macroregional strategy will enhance prospects for regional food hubs to be established in Ghana and will facilitate cooperation and coordination. | .Insufficient involvement of the stakeholders | Lack of training, capacity building, knowledge and technology transfer, human resources, and policy reforms and adjustments | Agriculture products have cheap production and marketing costs. Farm waste could be utilised to make organic fertiliser to help agriculture become more intensive. use of natural resources that is efficient and effective. food and nutrition security, and the reduction of poverty |

## 2.1.6  key challenges in designing a sustainable food supply chain using circular economy concepts.

In addition to the benefits of switching to CE from the linear approach in FSC, there are certain difficulties in actually putting it into effect. The key findings of earlier, more current research on the identification and analysis of CE adoption problems in FSC are shown in Table 2.1.Sharma et al. (2019) in the research observed that the poor government policy and implementation is the main challenge in food supply chain sustainability in countries like India, Bangladesh, and Pakistan. Ineffective recycling and waste management initiatives, a lack of environmental legislation, and a lack of sustainable policies are all challenges (Kumar, Singh, and Kumar,2021). In reference to Table 2.1 on the literature review, there are several challenges on the implementation of the sustainable food supply chain. Lack of Technology, Government policy and implementation.Lack of infrastructure, supply chain collaboration, lack of technical skill, customer awareness

 Technology utilization should attempt to enhance corporate operations' sustainability as well as efficiency and with this, Industry 4.0 and the circular economy are contenders to be complementary concepts (Garcia-Muia et al., 2019). Industry 4.0 is a set of concepts that aim to enable firms to modify their manufacturing processes and analyses enormous amounts of data in real-time, which will improve strategic and operational decision-making (Kagermann et al, 2013). This will enhance sustainability of the food supply chain especially in the developing economy

Additionally, developing economies lacked digital logistic infrastructure and support for information technology (IT) (Mangla et al., 2018). According Sharma et al (2019), the reaseach on the Indian food industries suggested that poor and outdated infrastructure for support the sustainability in the food industries is one of the challenges. From observation, poor facilities is one of the major challenges in the developing nation and the government should organize the stakeholders in investing the critical areas to support agricultural and food production.

Supply chain collaboration among the various stakeholders is another challenges faced with food sustainability in Ghana (Boon, E.K. and Anuga, S.W, 2020). Their research article, it is observed the various stakeholders including the government whose polices are inconsistent and poor implementation of the existing one to support food sustainability is one of the major issues. Organization alignment with other partakers in the FS chain network is also observed by this article as another the issue. Government especially in the emerging economy should lead the way in aligning with various stack holders on the proper policies and proper enforcement with strict supervision. Awareness is also to be created by the government on the need for the sustainable food polices with proper highlight on the benefits to the environment, social and the economy.

The consumer behavior is another challenges faced with the food sustainability implementation in Holland according to Kayikci et al (2022). The end product user may not really understand the implication on the change or traditional product design and may not be willing to commit his resources in the purchase of the product. Awareness needs to be created in other to prevent consumer’s misunderstanding of the situation.

Lack of technical skill is one of the difficulties FSC encountered in effectively implementing CE practice in the current Industry 4.0 age. For CE adoption in FSC, an efficient traceability system is needed to track the waste produced (Nandi et al., 2021). Since it keeps track of food waste, food quality and safety, and transparency, the FSC traceability is essential. But it's difficult to set up a traceability system (Sharma et al., 2019). Challenges are interconnected, with some serving as a cause or driver and others as an effect or drive, it has been discovered. To find new chances, it is crucial to examine and evaluate difficulties to comprehend their significance and role in growing CE practice.

Poor funding with high interest rate is another challenges faced with the implementation of the sustainable food supply chain in Ghana according to Boon, E.K. and Anuga, S.W, 2020. This is very peculiar to the emerging nations with double digit interest rate on loan. The stakeholders in the sectors should encourage loans to food production companies, farmers and the food network with low interest rate to enable the implementation of circular food supply chain in the emerging nations.

## 2.1.7 Key opportunities of Using Circular Economy Techniques When Creating a Sustainable Food Supply Chain

Industry-wide adoption of the circular economy has lot of advantages based on the previous literature and the review above( See Table 2.1) These opportunities ranging from low cost, low carbon emission to the atmosphere, cheap production of agricultural products and marketing costs. Farm waste could be utilized to make organic fertilizer to help agriculture become more intensive, food and nutrition security, and the reduction of poverty. Convertion of waste to Biofuels is also another advantage in adopting sustainable practices

Quynh et al (2021) on of food sustainability in the UK and Italy discovered that with the abundant of focus and proper reverse logistics there is an opportunity in reducing the cost of feeding of livestock with the adoption of Circular practice in the food supply chain industries , According to the research, the food waste in converted to feeds for livestock which creates additional job, and value to the process.

A review on the research of reuse of the waste water in Germany for irrigation on agricultural crop farms according to Maab, and Grundmann (2018), observed that governance structure's alignment with irrigation's unique characteristics and the associations of farmers' interdependence with one another support the reuse program's efficient functioning. Reusing wastewater gives a chance to lessen the demands on natural water resources and the discharge of pollutants to surface water bodies when done safely based on this review. This should be encouraged by supporting the developing nations on the need to adopt this method in reducing consumption of raw material and safety of the environment.

 According to Ada et al (2021) on research review in the European country observed that opportunities of decreasing the exploitation of raw material and allows resources circulation, creating products in accordance with customers satisfaction if sustainable practice is adopted.

Suhartini et al (2021) after the research in Indonesia observed that the use of food waste for domestic cooking by converting the waste to fuel. The fuel will be made from briquettes made from food waste which is far more affordable when it comes to price. Also will reduce the effect of waste disposal on the environment

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## 2.2 Conceptual Framework of the Study

A conceptual framework assists in first identifying and then explaining the important components of a study that are understood, valued, and desired to relate to other characteristics and forces that have an impact on the research (Ravitch & Riggan, 2016). This is mostly used in qualitative research as an inductive method (Ngulube, Mathiapa, & Gumbo, 2015). According to Ravitch and Carl (2016), it is a fundamental source of reflective thinking and behavior throughout the research process. On the figure 2.2 below illustrates all the key variables in moving from the formal (Linear Economy) of the aspect of the FSC to CE built on some of the finding in the literature review (see Table 2.1)

**Opportunities in Adopting CE Practice in FSC**

**Challenges in Adopting CE Practice in FSC**

1. The Large-Scale Sustainable Supply of Food
2. Low-Cost Supply of Food Loss and Waste Feedstock
3. Customers’ Shift Towards Natural-Based Products
4. High Market Demand for Fertilizer
5. Energy-Conversion Technology

-Low technological readiness

-Low reliability in estimation -High logistics cost /Collaboration

-Low customer acceptance -Safety concerns / Government polices

-Regulations

Supply locations

**Linear Food Supply Chain Design**

Supply of Farm Input

Farming & Harvesting

Food Processing

Sales Channel

 Consumption

**Waste Management**

 **Figure 2.3** Framework of the literature Review. Source – Literature Review (Aurthor)

#

**2.3 Summary**

The assessment of the literature on the food supply chain management's role in food sustainability revealed that numerous authors have investigated the subject using diverse methodological stances, including quantitative, qualitative, and mixed methodologies. How to attain food supply chain profitability through sustainable strategies and network optimization has been the subject of 20 research studies on various developing and developed countries. Diverse authors individually explored the dimensions of sustainability in relation to food supply chain management in the research on the topic of sustainable supply chain management.

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The next chapter will be on the research methodology, approach, design, and population of study, data presentation, data collection, and analysis.

**CHAPTER THREE**

#

# RESEARCH METHODOLOGY

## 3.1 Introduction

This qualitative study's goal was to investigate the difficulties and possibilities associated with implementing the circular economy in Nigerian food supply chain design. This entails exposing the activities that take place throughout the entire food supply chain and comprehending the opportunities and obstacles they encounter when implementing sustainability in Nigeria.

This chapter focuses on establishing the methodology and philosophy that the researcher deployed in this study. It enables the readers to understand what was done and how it was done to arrives at the conclusion. This chapter examines the research design, data collection methods and methods of data analysis. The justification of the chosen design in light of other potential designs as well as the function of the researcher will be discussed.

## 3.2 Research Philosophy

The research philosophy relates to the investigator's beliefs towards the study in which data is obtained, investigated, analyzed, and evaluated (Moon et al., 2019; Junjie and Yingxin, 2022). It revealed research assumptions about the study that reflected the approaches that had been applied to the objectives, as well as research design and research methodology to analyze and interpret the research's findings (Ryan, 2018).

There are four philosophical perspectives on research: Realism, Pragmatism, Positivism, and Interpretivism (Singh et al., 2019; Al-Ababneh, 2020):

Pragmatism describes the movement that comprises the claimant who gives a theory or ideology as accurate and if it functions well, that the pragmatic effect of adopting a statement defines its meaning, and that impractical concepts should be abandoned. Similarly,Mauthner (2020) defines realism as the perspective that accords things an independent essence of existence regardless of whether or not someone is considered viewing them.

Interpretivism was adopted due to the subjectively assessed and evaluated study of social reality and the focus of interpretivism is to convey people's experiences via analyses and interpretations of the research (Iovino and Tsitsianis, 2020). Based on the current study objectives, this study adapted interpretivism as its research philosophy. Additionally, interpretivism studies frequently emphasize meaning and may use a variety of techniques to represent various facets of the problem (Saunders et al .2012)

Another reason this research adopted interpretivism is because it is socially constructed, has multiple goals of understanding, weak predictions with specific interest that is unique, and deviant, and has an interactive, cooperative, participatory subject/researcher relationship (Pizam and Mansfeld ,2009). It also sought information on the behavior of people, their challenges and the solutions to the problem (Pizam and Mansfeld ,2009). The method of data collection of the interpretivist is based on realistic approaches like interviewing and observing and the theory is very mutual with secondary data research Collins, H. (2010), which indicates that in this study the findings usually emerge at the conclusion of the examination.

**3.3 Research Approach**

This study employed inductive approaches. According to Opie (2019), the research approach is a strategy that includes a series of steps that contain larger presumptions for method description, including data collection, analysis, and interpretation. The domain and kind of study that is being addressed determine the research methodologies. The inductive research method is described as beginning with the acquisition of facts pertinent to the researcher's area of interest (Rott, 2021). The inductive strategy focuses on the creation of the theory, whereas the deductive approach determines and tests a hypothesis using an existing theory. However, using inductive approach in this study offers a thorough and deep grasp of the issue studied. The inductive approach was used to condense interview data into a concise, summary format and establish distinct relations among the research objectives and the summary findings derived from the interview data, and develop a framework of the underlying structure of experiences that are evident in the interview data (Thomas, 2016

## 3.4. Research Design

According to Mello (2022), the qualitative method is a kind of natural science inquiry that seeks a deeper comprehension of phenomena. Therefore, the current study is a descriptive research design. The descriptive research designs help provide answers to the questions of who, what, when, where, and how associated with a particular research problem. Descriptive research is used to obtain information concerning the current status of the phenomena and to describe "what exists" concerning variables or conditions in a situation.

A realistic and explanatory method of studying many phenomena in the universe is provided by qualitative research (Denzin & Lincoln, 2013). In qualitative research, the goal is to identify, characterize, and recount how people behave in particular situations in relation to the phenomena being studied (Erickson, 2011). The qualitative tradition includes various philosophical viewpoints, cultures, knowledge eras, and methodologies with historical roots in anthropology, philosophy, and sociology and traces to Herodotus and Aristotle (Erickson, 2011; Merriam & Tisdell, 2016; Patton, 2015).

The qualitative method enables for participant involvement to gain insights into their experiences and wider attitudes (Merriam & Tisdell, 2016; Yin, 2016). In qualitative research, people's opinions and interests in their unique and natural contexts are discovered and described (Erickson, 2011). By using qualitative research, one can better understand how people perceive various situations and capture the richness of the setting (Yin, 2016). The goal of qualitative content analysis is to classify enormous amounts of text into an effective number of categories that represent related meanings and it goes beyond simply counting words (Weber, 1990).The purpose of content analysis is to provide information and comprehension of the phenomenon being studied (Downe-Wamboldt, 1992).As a result, the qualitative technique was better suited for this study to provide a thorough grasp of the sustainability phenomena in the participants' everyday environments and to comprehend their experiences in the context of their particular environments.

Unlike the quantitative research method that uses statistical techniques to analyse the data and focuses on using numbers to portray the data (Dietz & Kalof, 2009). The quantitative paradigm, which has positivist epistemological foundations in the natural sciences, places a strong emphasis on data quantification and adopts grounding theory's deductive methodology for developing and evaluating hypotheses. (Babbie, 2017) Despite the provisional and unpredictable nature of the results, statistical techniques, which are the primary drivers of quantitative analysis, aid in better decision-making (Leon-Guerrero, 2015). But the quantitative method, which emphasizes measurements and causality, offers less depth and richness (Babbie, 2017; Denzin & Lincoln, 2013). This study's qualitative technique was compatible with its goal of examining the challenges and advantages in adapting circular economy practice in designing a sustainable food supply chain in Nigeria from the viewpoints of supply chain professionals based on their actual working experience.

In order to fully comprehend the context-specific dynamics at play, this study's qualitative methodology was useful. The qualitative approach complies with recommendations for greater research into supply chain sustainability to offer information that quantitative studies might miss (Pagell & Shevchenko, 2014). A strategy for learning about supply chain operations was to conduct qualitative interviews with supply chain experts (Reefke & Sundaram, 2017). Additionally, interviews provided a deeper understanding of the sustainability sensations (Gualandris & Kalchschmidt, 2014). In order to promote research and practise, interviews with food supply chain and sustainable development managers may be used (Ahmad et al., 2016).

**3.4.1 Population of the Study**

The target population for this study is the entire Nigerian economy particularly the food supply chain market which includes: farmers, farmer inputs suppliers, food production and distribution channels as well as the consumers. The study's scope should be consistent with its title and address the relevant population or the target group. According to the objectives of the study, the researcher is free to choose these boundaries (Simon & Goes, 2013). In order to do this, the study's scope was constrained to Nigeria, an emerging economy.

12 participants were approached for the interview but only 9 accepted to partake. The position of the nine (9) participant cuts across senior and midlevel staff of the food supply chain in Nigeria which includes large food retail shops, food processing companies, raw food distribution company, government food and drug agency. The participant positions includes Managers/deputy, executive, supervisors, consultants and coordinators. The range of the ages of the participants are between 40 to 65 years. All the interview were conducted in English language and no translations. 8 out of the 9 participant had university bachelor’s degree from various filed, 2 out of the 9 participant had Master’s degree while one (1) out of the 9 participant whom is an executive director of the executive food retail had a PHD as shown in Figure 3.1 below

 Education Age Professional Experience

 **Figure 3** Demographics

## 3.5 Sampling Technique

The sampling procedures are the methods and strategies used to collect data from the population. Employing particular sampling strategies for the target audiences aids the researcher in conducting a better evaluation of the research study. As a result, the sampling technique offers data from the intended audience (Queirós et al., 2017).

Purposive sampling was adopted in this study so that the section that is believed to be representative of the entire food supply chain in Nigeria are contacted in order to produce more accurate insights to the findings of this study. Age, geography, desire to participate, and relevant experiences of possible participants were all taken into account as part of the sampling plan for this study. Participants had to be at least 18 years old and had worked in Nigeria's food consumer products/ manufacturing sector for at least three years as supply chain practitioners. This sampling method is more accurate since it relies on the opinion of people who are acquainted with the fundamental challenges and opportunities in the food supply chain in Nigeria.

The qualitative methodology made it possible to connect with participants in their distinct natural setting and gain insights into their experiences and wider perspectives (Merriam & Tisdell, 2016; Yin, 2016). This study's main goal was to examine the opportunities and challenges associated with adopting a circular economy approach when constructing the food supply chain from a developing economy position. This study was qualitative in nature.

The purposive sampling utilized the important experts' group characteristics technique (Bloor & Wood, 2006; Patton, 2015). These are the people who are highly knowledgeable about a subject. In order to gather pertinent data for addressing the research questions, participants were chosen from the desired food sector using the key knowledgeable technique who had relevant experiences with the issue being studied (Ravitch & Carl, 2016).

## 3.6 Data collection method

Data collection methods are described as systematic strategies for gathering and correctly collecting information and data from various sources to convey the insights and responses of the research hypothesis testing and assessment of study outcomes. According to Nanna (2022), there are two types of data collecting methods: primary data collection and secondary data collection. Primary data collection refers to gathering information directly from the source, while secondary data collection involves gathering information from other sources (Taherdoost, 2022).

The interview process was created by myself specifically for this study and to address the main research topic. The interview questions should be detailed enough to elicit from participants information that is pertinent to the study's objectives (Rubin & Rubin, 2012). As a result, open-ended interview questions were created with the intention of enabling a thorough examination of participants' experiences in order to gather rich data (Turner, 2010)

I conducted the semi-structured interview technique as the lead researcher for this study and research tool to get data from participants. The interview questions is designed to be read to the respondent via his preferred means of communication. In order to find those eager to participate in the research based on the study's objectives, participant selection is essential (Creswell & Poth, 2018).Access to participants was taken into account as part of the research objectives for this study. I gained access to site porters through my social network and was able to ask for authorization to send invitations to research participants to food supply chain participants. The main objective of this study was to investigate on the challenges and advantages adopting Circular Economy in designing food supply chain experts in the consumer products have integrated sustainability principles into their supply networks. This query provided insight into the difficulties or implementing sustainable supply chain management. Insights into the viewpoints of food supply chain professionals regarding sustainable supply chain management were also made clear by this research question.

The purposive sampling utilized the important experts' group characteristics technique (Patton, 2015).In order to gather pertinent data for addressing the research questions, participants from the desired population who had experiences similar to the phenomenon under study were chosen using the key knowledgeable technique ( Ravitch & Carl, 2016). There are semi-structured interviews which include 3 sections based on the research question (see Appendix A). In Lagos, Rivers, Nigeria, I conducted data collection as the researcher via phone network. The interview took place in less than a week at a time that worked for the participants. The interview sessions took 20 to 30 minutes to complete.

## 3.6.1 Data Collection instrument

Any tools or procedures that help researchers obtain information and proof from participants in research operations are considered instruments for data collection. Additionally, they provide a sense of how the researchers collect knowledge and data to arrive at the study's conclusions (Clark et al., 2018).Semi structured interview was used in collection of the primary data.

I conducted participant interviews while keeping track of any observed behaviours and environmental clues as the principal data collector for my MBA research project. I respectfully questioned the contributors as they discussed their experiences and made sure that my note-taking did not take their attention away from them. There was absolutely no conflict of interest because this study (interview) was carried outside the UK (in Nigeria). The interview was done via phone call and recording

## 3.7 Data analysis method

The data analysis method assists researchers to communicate their findings using a variety of strategies to provide accurate and precise conclusions (Pandey & Pandey, 2021). This study deployed content analysis and interview methods. The content analysis approaches are useful for identifying the key variables that affect the participants’ behavior through a rigorous literature review while the interview avenue collected directly from the expatriates.

The interview provides bases for the analysis of respondents' ideas and thoughts (Riger & Sigurvinsdotti, 2016; Nawaz 2018). The interview is recorded on a device to ensure that no vital information is missing. The researcher transcribed the interviews which have taken a long time but are necessary to obtain useful information. The data obtained were analysed in subsection according to questions in the interview questionnaire above. In qualitative research, several basic methods for organising and evaluating data must be taken into account as part of the overall analysis plan. The issue of developing meanings for the enormous volume of the aforementioned data acquired is a hindrance to the qualitative analysis, which includes the processes a researcher takes in reviewing data collected to produce logical responses to the research questions (Rubin and Rubin, 2012).

Researchers will need to think about the structure of the acquired data, the main research topic, the analysis approach to apply, how to handle outliers, and the usage of computer-assisted tools. The information gathered for this study directly answered the main research question. The examination of the data revealed detailed comments from food supply chain experts in the manufacturing of consumer goods about their experiences integrating sustainability principles into their food supply networks.

## 3.8 Instrument Validity

 Validity is the extent to which a measuring device measures what it is intended to measure. The purpose of content validity is to guarantee that the scale's contents are broad enough to encompass the entire scope of the topic.

Researchers serve as the main data gathering tool in qualitative research (Ravitch & Carl, 2016). Data collecting plays a vital role in the research process as part of the overall research plan. Data are the foundation of a research investigation since research is about data (Yin, 2016).A semi-structured interview guide was used as the primary data gathering tool (see Appendix A). A researcher could utilize the interview guide's written questions to start or continue an interview and elicit further information about the subject at hand (Rubin & Rubin, 2012) .This interview guide ensured that the questions were the same for all participants, which improved rationality (Patton, 2015).

On the plus side, interpretivism's acceptance has made it possible to study qualitative research areas like cross-cultural variations in companies, ethical dilemmas, leadership and the examination of factors influencing leadership, etc. in great detail and because the information used in these research tends to be reliable and honest, primary data produced through interpretivism studies may have a high level of validity (Collins, H. 2010).

**3.9 Instrument Reliability**

Additionally, construct validity examined the precise measurement of the many occurrences linked with the construct. The items in the research instrument will be validated and approved by the project manager, who will make any required modifications to the question. And guarantee that the instrument consistently with a high degree of reliability measures for what it is intended to measure.

In order to show the calibre and rigour of the procedures, decisions, and conclusions, the research's reliability is essential. Reliability includes the research's design, methodology, data, analysis, and conclusions (Toma, 2011). The research must accurately reflect the data gathered from participants on the ground while also taking into account competing and alternative interpretations (Patton, 2015; Ravitch & Carl, 2016; Toma, 2011) To demonstrate the accuracy of the research beyond a reasonable question, reliability is crucial in qualitative studies. The research was made more reliable by the aggressive pursuit of anomalous or unfavorable patterns during the iterative data gathering and analysis phase, as well as by the use of detailed explanations when presenting the results.

# 3.10 Summary

The goal of this study was to look into the opportunities and difficulties associated with implementing the circular economy while creating a sustainable food supply chain in Nigeria. The research questions centered on getting detailed feelings from experts in the food supply chain in the consumer products in food industry on challenges they've encountered when applying sustainability principles in their manufacturing/food supply procedure.

An industry background of at least five years in the production or supply of food, as well as a willingness to participate, were requirements for participation. As saturation was reached, interviews with a purposive sample size of 9 people were conducted. The interview process took place online (phone call).

The test process, setting-specific contextual elements, data collection, analysis, issues of reliability, and findings will all be highlighted in detail in the next chapter.

**CHAPTER FOUR**

**DATA PRESENTATION AND DISCUSSION ON THE RESULT**

**4.1 Introduction**

Chapter four focuses on presenting and discussing the key results of the research. The study explored the challenges and opportunities in adapting circular economy practice in designing a sustainable food supply chain in Nigeria.

* 1. **Data Presentation**

The finding of this study are met by a thorough analysis of the literature and telephone interviews with significant figures in the Nigerian food supply chain business. As a result, the final participants in this study will be divided into four: processing food companies, distribution channels, end users and external supply chain stakeholder. These participants were chosen based on their various experience in the food sector and the interview conducted through phone call to respondents. 12 respondents were contacted out of which 9 responded to the call and their responses recorded on a paper and summarized to answer the questions raised in the study. A total of 16 research questions were raised. The participants are classified into A,B,C,D,E,F,G,H and I (representing 9 participant in the interview).This is for easy identification when analyzing the findings. The interview questions was developed based on the objectives of this study, literature review and a thorough investigation covering the situations uncovered during the pilot study.

Table 4.1 Highlight of key findings:

|  |  |
| --- | --- |
| Research Objective  | Most Important findings  |
| Significance of adopting CE practices  | Majority of the respondents identified CE practices as source of competitive advantages as well as a solution to contemporary environmental issues. Majority of the respondent mentioned increase in profit, customer satisfaction Employment opportunities, preservation of raw material  |
| Key challenges of adopting CE | * **Top level challenge**: Government policies and implementation, Lack of technology, Poor infrastructure
* **Medium level challenge**: Collaboration with stakeholders, customer awareness, funding/ high interest rate, corruption
* **Low level challenge**: management decision, market preference,
 |
| Key opportunities of adopting CE | * Competitive advantage , Profit maximization, Cost reduction, Environmental safety, job creation
 |

 Source – Interview Data

**Significance in adopting CE Practice**

**Competitive advantage-** Majority of the respondents identified sustainable practices as source of competitive advantages as well as a solution to contemporary environmental issues

Participant A - said that sustainability will always attract more clients to the company’s business.

Participant F – (Logistics manager for food distribution Company). Mentioned that they have a reverse logistics system that ensure that their customers send back items in relation to the terms and conditions. ‘’ Of course, yes . we retain our customers due to this additional services’’

**Environmental Practices** - All the respondents said that they understand the need and implication of the sustainable environmental practices but 7 out of the 9 respondent said they have some related environmental practice.

Participant C - ‘’Yes, yes. We have a solar panel powered batteries of which the company uses for at least 30 to 40 hours a week especially during the down times to reduce the cost of using generating sets to power electricity and as well reducing the carbon emission. yeah’’

Participant D ( Retail outlet Supervisor) Said the company have reverse logistics that ensures the backload of good from the client when required.

Participant G (Coordinator - food distribution company) - said ‘’Yes, you do not have to complicate issues with you host community’’, We have a system where our food waste is managed by the government agency.

Participant I (Government agency for Food) – Said that all the food outlets are mandated by the agency to compile with the food waste management regulation. He said that on a yearly basis, the retail outlets are given approval called GHP ( while the food processing company are given Certificate renewably 5 years wi th the agreement to complie with all the food safety procedure including management of waste via Local waste mangemnen

**Reduction of Cost -** 7 out of 9 participant said that sustainability practice will reduce the cost of doing business at the long run.

Respondent A – (Food manager processing company) said that the company do not recycle but have a system where by the state government agency (LAWMA) manages the food waste for them and is cheaper. ’We pay LAWMA on a monthly basis to evacuate our food waste.’’

Participant E (Supervisor food outlet ). Mention that the company have a vendor that supplies them with recycled food packing items which is cheaper.

**Risk management** – All the respondent said that there are a lots of risk associated with the sustainable practice**.**

Respondent A – said there is a lot of risk that needs to be managed when trying to adopt food sustainability.

 Respondent C - Said, ‘’there are risk management in all we do here in the company. Before we do anything including changing from one procedure to another. Yes, in all we do’’

Respondent G – Mentioned that the risk management is an issue but said is mostly case by case basis. He said the most area that the company considers most risk is the case of import. Because government agencies are usually involved in the process and is one of the most difficult issues working the external stakeholder including the banks.

Respondent I (Government agency for Food) – Yes , we have a procedure on inspection of the food for importation. The agency do a source impaction of the factory of manufacturing both in country or outside the country and then a NAFDAC number will be allocated go the product which will be on the body of the product for identification at all time. A regular routine check on the food processing and retailing facilities is done on a monthly basis or so will (depending). Any company found violating these procedure will be sealed. This way the consumption of substandard food in the country can be avoided.

**Key challenges in adopting CE practices**

All the participant identified various challenges they face implementing the CE practice in food supply chain in their various organizations. There are different barriers mentioned by various participant which includes poor infrastructure, Government policies and implementation, lack of funding, Lack of Technology, collaboration with other food supply chain organization, customer awareness,

**Cost implication.** 6 out of the 9 participant mentioned cost as one of the limitation in attending food sustainability

Participant B(Deputy manager Retail food outlet) said that there are cost implication if the objective in being sustainable is considered .You might have a situation where companies choose not to expand in certain areas, are not to throw certain parts of their portfolio because they can't meet the sustainability targets for the area due to high cost

Participant D (Retail outlet Supervisor) – Said on cost implication ‘Yes, if you are going to have food sustainability, you have to get serious as a company’’

Participant F (Logistics coordinator) said that there is always cost increase when a company wants. ‘’Yes, our company is thinking towards repacking of our outdoor delivery plastics for recycling’’ but will come with additional cost.

**Government** **policies and implementation**– 8 out of the 9 participants said that unclear policies and lack of policy implementation of government and its agencies is one of the main hindrances in attending food sustainability.

Participant A - Mentioned that ‘’As far as he is aware, there is no clear polices from the Government of Nigeria or its regulatory bodies on the direction of food sustainability procedure’’

Participant C (Manager food retail outlet) - Said that ‘’Government is the number one problem on the food sustainability in Nigeria. Their policies are not clear especially when it comes to food sustainability’’.

Participant H (Executive Director) - Mentioned lack of consistency in the policies of government from one political regime to another as one of the main issues on sustainability in food sector.

Participant G (Coordinator of food distribution company) said – ‘’ Lack of political will from the Nigeria politicians in Government is the main factor hindering food sustainability’’

Participant I (Government agency for Food and drugs) – Mentioned lots of bottleneck in the process of food company applying for inspection and food analysis report. According to him ‘’ yes you know my brother. Is always an issue with government at Local, State and federal level. Correct there is form of delays in the process’’

**Collaboration with stakeholders** - 6 out of the 9 participant said that collaboration inefficiencies like transparency, capabilities and uncertainties of various stakeholders especially the external is one of the issue faced with food sustainability. The collaboration between the food supply chain stakeholders is still one of the factors.

Participant B – Said ‘’some suppliers are not meeting up the criteria regarding deliveries’’

Participant D (Retail outlet Supervisor) – mentioned that the some of the suppliers are not really transparent in their transaction that they pull a lot of surprises when it comes to supply delivery.

 Participant C ( Manager food retail outlet)– said ‘’ Government and its agencies are very very difficult to engage with. Many at times. Yes ‘’

Participant G – engaging the external stakeholder like the government agencies is very difficult most of the time.

Participant I (Government agency for food and drugs) - mentioned that they have procedures

**Context.**  Of the 9 participants,8 discussed different contextual factors, such as challenging economic conditions that influence consumer decisions and encouraging the purchase of inferior goods, as well as ignorance, High interest rate and funding , lack of infrastructure, , lack of technology, and expertise

Participant B (Deputy manager Retail food outlet)– mention ‘’ lack of customer awareness’’ as one of the factors affecting food sustainability. ‘’When people do not know what the massage is all about of the product change in price and packaging’’

Participant C - mentioned lack of infrastructure as one of the problems. ‘’Poor road facilities for the movement of perishable raw food from the Northern parts of Nigeria down to south,and the on transit cold storage is still not enough. Yes, there is no train transportation facilities as well, for easy movement of food items. it have increased our cost as well’’

Participant D (Retail outlet Supervisor)– mentioned lack of technology in recycling waste food item. ‘’We do not involve in recycling due to lack of technology. That is a no, no. We have some livestock farmers whom collect our food waste on daily bases in order to convert it and make feeds for their livestock’’. Also he mentioned the Council government agencies (LAWMA) is responsible for collecting the food waste and managing it . ‘’We pay them on a monthly basis for the services’’

Participant H - mentioned the use of generator to provide electricity which is very common in the food processing due to lack of electric power in Nigeria. ‘’This is harmful to the atmosphere especially now that we are worried about climate change. Oh yes, lots of rainfall had just destroyed most of the farmers land products in Nigeria ’’

**Key opportunities of adopting CE Practices**

**Environment** – All the 9 respondent understood the benefit of environment as regards food sustainability. However 6 out the 9 respondent said that they have practice in their various organization that is environmental friendly.

Participant A - said that the company do not recycle but have a vendor who supplies some of the recycled material used for food packaging and processing.

Participant B- Said ‘’Yes, oh yes, we have a reverse logistics that collects back our product based on customers request/ agreement or we refund if the customer returns by himself. Sure, it is only for our big clients’’

Participant D (Retail outlet Supervisor)– said the his organization have solar powered energy with batteries which they used on average of 38 hours in a week to reduce the cost of powering the electricity with generating set.

Participant H – Mentioned that they have sort of an agreement with the livestock farmers who collects the food waste on a daily bases in other to convert to feeds for their livestock.

**Economy** All the participants said that they have understanding of the benefits associated with the sustainable practice in the organization.

 Participant B - said his organization have created a big competitive advantage in their reverse logistics activities by gaining the trust of their client.

Participant D – ‘’ we have save a lot of revenue using solar energy at the long run’’

Participant H – said that the company made more income in disposing the excess food on a daily basis. The livestock farmers collects it to convert it to feeds

Participant G - mentioned that it creates additional avenues for profit making for the organization.

* 1. **Discussion**

This section of the study concentrates in discussion of significance of adoption of circular economy practice in designing sustainable food supply chain, examines key challenges and opportunities for food supply chain in Nigeria.

**4.3.1 The Significance of Sustainable Food Supply Chain Design in Nigeria.**

Nigeria with a population of over 200 million people need to ensure that food production boosted to reduce the level poverty in the country. Protecting human rights, halting environmental deterioration, and accounting for value and cost were some of the strategies for attaining food sustainability. All the participant understood the importance of food sustainability which are for social, economy and environment. Most of the participants mentioned that the sustainability approach will have a competitive advantage to the organization, Safety of the environment is one of the issues mentioned by the participants. Preservation of the natural resources is one of the advantages mentioned by the participant.

**4.3.2** **Challenges in Designing a Sustainable Food Supply Chain with Circular Economy Practices.**

Previous studies and the interview data have numerous factors challenging transition to circular food supply chain. The interview participants also mentioned the issues of financial resources, poor infrastructure, collaboration with some stake holders, lack of Technology/ Technical know - how , organizational culture and management, customer awareness, uncertainty about benefit/Risk management, cost implication, Weak government policies and implementation, lack of market preference,

Lack of financial resources is one of the challenges indicated on the literature review (see Table 2.1) and interview with the participant. According participant A (Manager food Processing company) who mentioned high interest rate and strict conditions on loan facilities to organizations in Nigeria as one of the major issue in food sustainability .The participant said that the mark up on the loan (interest rate) is very high with the condition attached well.

Lack of management commitment, and inadequate management capacity. Participant B mentioned the management interest in the decision making as one of the factor affecting the circular food implementation due to uncertainties. This also complies with the literature as

Poor infrastructure is also reflected on the literature review, the participants mention poor road for transportation, lack of electricity, and alternative meansof transportation of good especially from the northern part of the country to the south.

Uncertainty about benefits is aspect in unknown profit with risk management was one of the factors affecting food sustainability .Participant mentioned that feasibility planning and strategy are important to the execution of food sustainability practice. In all these factors management role in the implementation is very important since they are the leading hierarchy in the organization’s decision making. Environmental uncertainties is also another factor, like one of the participant mentioned in an interview on the recent flood in Nigeria which destroys some of the farmers agricultural product due to rain fall ( Climate Change).

 Absence of strong government policies and implementation to boost CE implementation of sustainable practices was mention by one of the participant. Participant 1 (Government agency on food and drugs) mention the overall government procedure that is very slow which is one the problems in regulations implementation.

Lack of market preference and pressure from both customers and consumers

Supply chain actors are reluctant to collaborate/support CE initiatives. The collection and processing of the waste streams could be quite challenging at supply chain level. This is especially the external stakeholders like government agencies.

**4.3.3 Opportunities to Use Circular Economy Principles When Creating a Sustainable Food Supply Chain**

Majority of the participants mentioned the opportunities of sustainable food practices on the interview which includes, food security, increase profitability for food supply chain firms, job creation, competitive advantage and environmental safety. Participant (I) who mentioned that the government ensures that the food waste is managed with the State government agency who collects the waste and dispose of it. According to the participant, the government ensures compliance by issuing a certificate to the food outlet which is renewable on the yearly basis while the food processing company is renewable for the period of five year. This gives the Federal government agency (NAFDAC) the opportunity to inspect the facilities for compliance before renewing the certificate. Some of the gap is that

**4.4 Summary**

**T**his chapter discuss how the data were analyzed and how the conclusions related to the study's main research question. The results demonstrate that food supply chain professionals understand sustainability strategies that take into account social, environmental, and economic factors. The results also demonstrate that for sustainable performance in the food supply chain, internal and external stakeholders must work together and coordinate.

The results will be interpreted in the following chapter within the framework of the body of information as mentioned in Chapter 2 of the literature review. Also provided will be an examination of the results in light of the theoretical and conceptual framework. In addition, I'll go over the study's conduct's limitations, conclusions, and implications for practice and societal change. The chapter will end with a summary of the main point.

**CHAPTER FIVE**

**SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATION**

**5.1 Introduction**

This chapter offers an overview of results, makes conclusions, & offers potential directions for implementing the Nigeria's food supply chain's circular economy design.

**5.2 Summary of Findings**

A lot of attention has been paid to the circular economy (CE) in recent years due to its potential to address today's economic, social, and environmental problems. The food organizations are pushing for implementing a circular economy measures to improve the supply chains' social, economic and ecological sustainability. Food system specialists are enthralled with the idea of the Circular Economy (CE) as workable answer to all the upcoming uncertainties & challenges (Babbie et al., 2017; Saidi et al., 2021). A sustainable paradigm called CE seeks to develop a mechanism that is both restorative and regenerative (Laso et al., 2018).

Food is among the most fundamental necessities for individual survival, & supply chain is crucial in getting food from producers or farmers to consumers, whether it has been processed or not (Wang et al., 2021). The supply chain is concerned about feeding a growing global population, & the FSC notes pressure to provide all people with environmentally friendly & safe food. Consequently, reducing food waste and feeding people urgently demand sustainable development in the FSC. The shelf life of food goods is limited and they are perishable, leading to a significant quantity of waste being produced throughout the entire supply chain, including during harvesting, processing, shipping, & consumption. FSC presents a significant issue to sustainable development because Food losses and waste directly affect biological deterioration, which affects the world economy, poverty, and food insecurity (Ali et al., 2019).

This study offered a multi-stakeholder viewpoint on the difficulties facing circular food supply networks. No matter how directly or indirectly a stakeholder is involved; the findings provide insights to all parties (Ada et al., 2021). This section presents novel findings that hadn't been reported in the literature before and outlines crucial guidelines for future investigations.

In comparison to rich countries, it is more challenging for poor countries to create circular economies and sustainability measures. Nigeria, the most populous country of African descent in the world, has poor laws that hinder the adoption of CE. However, it was discovered that among the key reasons why there are obstacles in the food sector was lax implementation of such environmental rules. Given the position the Nigerian government has taken on the circular economy, it’s ironic and challenging to ponder about (Boon 2020; Bressanelli et al., 2019).

Environmental protection is not a priority for the majority of Nigerian businesses and consumers which is another major cause barrier (Ahmad et al., 2016). As a result, the general population does not share or support the government's objective for CE. The significance of policymakers in Nigeria tackling difficulties with bureaucracy, governance, corruption, and environmental education is seriously impacted by these findings.

According to a survey of the literature, there are several obstacles to designing a sustainable food supply chain using a circular economy:

Lacking the funds necessary to deploy CE. a lack of design, process, and supply chain skills, as well as a lack of supporting technologies. lack of knowledge about best practices and the technology that are available. The adoption of CE is hampered by organizational culture. Weak management abilities and a lack of managerial commitment. Those involved in the food supply chain reluctance to change. Uncertainty regarding possible financial, environmental, and economic advantages of CE, particularly any possible tax advantages. Lack of scale economies when installing CE. High expense of applying CE and potential harm to scale economy Lack of environmental enforcement and rules to facilitate CE adoption. Pressure from clients and consumers, as well as a insufficient market demand, lack of assistance or cooperation from supply chain participants.

Additionally, this study demonstrates that adopting CE for establishment of sustainable and environmentally friendly food supply chain has a number of advantages, including: a competitive advantage, increased profitability for food supply chain businesses, increased food security, the creation of jobs, and environmental safety.

**5.3 Conclusion**

Nigeria's rapid resource consumption and solid waste generation pose a serious danger to the country's sustainability. The Nigerian government must make significant investments in implementing circular economy principles in order to overcome the obstacles involved with recirculating waste materials. This study pinpoints and examines the precise obstacles to incorporating circular economy methods in Nigeria's domain food supply chains. This subject merits investigation due to the severity of how food supply systems affect the environment and the paucity of study on sustainability methods in Nigeria.

The initial original contribution of this approach is to define circular food supply networks for perspective of incorporating the circular economy idea with food supply chain management, which is a recent field of study and practiceT in supply chain sustainability.

This report carefully examines and ranks the obstacles to Nigeria's circular food supply chains. We looked at the perspectives of four judging groups: food processors, food sales, government authorities & food distribution networks. The findings point to a lack of cooperation and support from supply chain participants as well as insufficient environmental rules as the primary causes of impediments, and enforcement. In addition, a lack of infrastructure and inadequate technologies stand out as the biggest obstacles.

By summarizing, this Chapter analyses the consequences for circumventing/overcoming the constraints from a theoretical and practical standpoint. It provides fresh perspectives for potential supply chain sustainability research directions.

**5.4 Recommendations**

The circular economy's implementation in the establishment in Nigeria of a sustainable food supply chain faces inherent challenges, according to the extensive and comprehensive body of literature studied and the results of the surveys included in this study. The barriers recognized in this study serve as the foundation for these recommendations:

Nigeria has adopted a backwards approach to promoting & adopting circular economy practices is a part of national policy, in the agricultural sector. Low bureaucratic status and pervasive corruption have made it more difficult to enforce such environmental legislation than to enact them.

Involving in the food supply chain, at micro, meso, & macro levels of organization, the government needs to create an efficient enforcement system. However, it is essential to create pertinent indicators in order to guarantee CE implementation at every level. The government may take into account broad criteria and indications that businesses can modify or customize to represent their own traits, circumstances, and issues. These indicators ought to include thorough explanations, goals tailored to the industry, and consistent methods for gathering, measuring, and submitting the necessary data. The indicator system has to be monitored and enforced using stricter regulatory measures. To guarantee optimum compliance, the food business should be made aware of these indications, along with other industries.

The majority of environmental policies in Nigeria don't incorporate any kind of public input. The Nigerian political system's lack of a formal institutional framework for this further undermines the interest of the public in & understanding about environmental projects like the circular economy practice. As a result, this study suggests a broad advertising strategy that includes interactive venues like exhibitions, conferences, and workshops as well as traditional media like the internet, social media, TV, radio, and newsletters. Environmental education and CE must be included in schools if the public's interest in and knowledge of the sustained the circular economy in practice is to be maintained. Additionally, from a strategically perspective, this study recommends cooperative systemic sustainability among important players in the Nigerian food supply chain, with a clear interest on enhancing outcomes for the economy and the environment.

**5.5 Limitation of the Study**

This idea has some limits despite making a number of contributions. First off, even if it was sufficient to achieve the study's goals, the list of hurdles was by no means complete. The listing of obstacles among one of most pertinent theoretical approaches revealed in this research study may be expanded in subsequent studies in order to better serve their research goals. Secondly, this study examined feedback from various Nigerian parties involving in food supply chain. Farmers, who are significant players for food supply chain, could not be incorporated into research because of poor data quality.

 Also, the research was limited to the western (Lagos) and southern part of Nigeria due to time factor.

 Last but not least, it was impossible to get in touch with one of the organizations responsible for waste management in Lagos, Nigeria, to ask how they handle the whole amount of food waste that is gathered from all restaurants and residences.

**References**

.Ada, N., Kazancoglu, Y., Sezer, M. D., Ede-Senturk, C., Ozer, I., and Ram, M. 2021. Analyzing barriers of circular food supply chains and proposing industry 4.0

Ahmad, W. N. K. W., Rezaei, J., Tavasszy, L. A., & de Brito, M. P. (2016). Commitment to and preparedness for sustainable supply chain management in the oil and gas industry. Journal of Environmental Management, 180, 202-213. doi:10.1016/j.jenvman.2016.04.056

Ali, S. M., Moktadir, M. A., Kabir, G., Chakma, J., Rumi, M. J. U., & Islam, M. T. 2019. Framework for evaluating risks in the food supply chain: Implications in food wastage reduction. Journal of Cleaner Production, 228(2019), 786–800.

Al-Saidi, M., Das, P., & Saadaoui, I. (2021). Circular Economy in Basic Supply: Framing the Approach for the Water and Food Sectors of the Gulf Cooperation Council Countries. *Sustainable Production and Consumption*, *27*, 1273-1285. https://doi.org/10.1016/j.spc.2021.03.004

Babbie, E. (2017). Basics of social research (7th ed.). Boston, MA: Cengage Learning. Balfaqih, H., Nopiah, Z. M., Saibani, N., & Al-Nory, M. T. (2016). Review of supply chain performance measurement systems: 1998–2015. Computers in Industry, 82, 135-150. doi:10.1016/j.compind.2016.07.00

Boon, E.K., Anuga, S.W. (2020). Circular Economy and Its Relevance for Improving Food and Nutrition Security in Sub-Saharan Africa: the Case of Ghana. Mater Circ Econ 2, 5. https://doi.org/10.1007/s42824-020-00005-z

Bressanelli, G., Perona, M., & Saccani, N. (2019). Challenges in supply chain redesign for the circular economy: A literature review and a multiple case study. International Journal of Production Research, 57(23), 7395– 7422. <https://doi.org/10.1080/00207543.2018.1542176>

Boon, E.K., Anuga, S.W. Circular Economy and Its Relevance for Improving Food and Nutrition Security in Sub-Saharan Africa: the Case of Ghana. Mater Circ Econ 2, 5 (2020). https://doi.org/10.1007/s42824-020-00005-z

Borrello, M., Caracciolo, F., Lombardi, A., Pascucci, S. and Cembalo, L. (2017), “Consumers’ perspective on circular economy strategy for reducing food waste”, Sustainability, 9(1),136-141.

Borrello, M., Lombardi, A., Pascucci, S. and Cembalo, L. (2016), “The seven challenges for transitioning into a bio-based circular economy in the Agri-food sector”, Recent Patents on Food, Nutrition & Agriculture, 8(1),39-47.

Bressanelli, G., Perona, M., & Saccani, N. (2019). Challenges in supply chain redesign for the circular economy: A literature review and a multiple case study. International Journal of Production Research, 57(23), 7395– 7422. <https://doi.org/10.1080/00207543.2018.1542176>

Chemat, F., Rombaut, N., Meullemiestre, A., Turk, M., Perino, S., Fabiano-Tixier, A., & Abert-Vian, M. (2017). Review of Green Food Processing techniques. Preservation, transformation, and extraction. *Innovative Food Science & Emerging Technologies*, *41*, 357-377. https://doi.org/10.1016/j.ifset.2017.04.016

Ciccullo, F., Cagliano, R., Bartezzaghi, G., & Perego, A. (2021). Implementing the circular economy paradigm in the Agri-food supply chain: The role of food waste prevention technologies. Resources, Conservation and Recycling, 164(2021), 105114. https://doi.org/10.1016/j. resconrec.2020.105114

Clark, K.R. and Vealé, B.L., 2018. Strategies to enhance data collection and analysis in qualitative research. Radiologic Technology, 89(5), pp.482CT-485CT.

Corrado, S., Caldeira, C., Eriksson, M., Hanssen, O. J., Hauser, H. E., van Holsteijn, F., Liu, G., Östergren, K., Parry, A., Secondi, L., Stenmarck, Å., & Sala, S. (2019). Food waste accounting methodologies: Challenges, opportunities, and further advancements. Global Food Security, 20, 93–100. <https://doi.org/10.1016/j.gfs.2019.01.002>

Collins, H. (2010) “Creative Research: The Theory and Practice of Research for the Creative Industries” AVA Publications

Creswell, J. W., & Poth, C. N. (2018). Qualitative inquiry and research design: Choosing among five approaches (4th ed.). Thousand Oaks, CA: Sage.

Dania, W. A. P., Xing, K., & Amer, Y. (2018). Collaboration behavioural factors for sustainable Agri-food supply chains: A systematic review. Journal of Cleaner Production, 186(2018), 851–864. https://doi.org/10. 1016/j.jclepro.2018.03.148

De Angelis, R., Howard, M., & Miemczyk, J. (2018). Supply chain management and the circular economy: Towards the circular supply chain. Production Planning &

Demestichas, K., Peppes, N., Alexakis, T., & Adamopoulou, E. (2020). Blockchain in agriculture traceability systems: A review. Applied Sciences, 10(12), 4113. https://doi.org/10.3390/app10124113

Denzin, N. K., & Lincoln, Y. S. (2013). The discipline and practice of qualitative research. In N. K. Denzin, & Y. S. Lincoln (Eds.), The landscape of qualitative research (4th ed., pp. 1–41). Thousand Oaks, CA: Sage.

Dietz, T., & Kalof, L. (2009). Introduction to social statistics: The logic of statistical reasoning. West Sussex, United Kingdom: Wiley-Blackwell

Do, Q., Ramudhin, A., Colicchia, C., Creazza, A., & Li, D. (2021). A systematic review of research on food loss and waste prevention and management for the circular economy. *International Journal of Production Economics*, *239*, 108209. https://doi.org/10.1016/j.ijpe.2021.108209

Erickson, F. (2011). A history of qualitative inquiry in social and educational research. In N. K. Denzin, & Y. S. Lincoln (Eds.), The SAGE handbook of qualitative research (4th ed., pp. 43–58). Thousand Oaks, CA: Sage

European Commision, 2022. *European Commision.* [Online] Available at: <https://climate.ec.europa.eu/index_en> Accessed 1-11-2022

Farooque, M., Zhang, A., & Liu, Y. (2019). Barriers to circular food supply chains in China. Supply Chain Management, 24(5), 677–696. https:// doi.org/10.1108/SCM-10-2018-0345

FAO (2018) World fertilizer trends and outlook to 2018 Data available at

http://www.fao.org/3/a-i4324e.pdf (2018) Accesed 1-11-2022

Gardas, B. B., Raut, R. D., & Narkhede, B. (2018). Evaluating critical causal factors for post-harvest losses (PHL) in the fruit and vegetables supply chain in India using the DEMATEL approach. Journal of Cleaner Production, 199(2018), 47–61. https://doi.org/10.1016/j.jclepro.2018. 07.153

Genovese, A., Acquaye, A. A., Figueroa, A., & Koh, S. L. (2017). Sustainable supply chain management and the transition towards a circular economy: Evidence and some applications. Omega, 66(2017), 344–357. https://doi.org/10.1016/j.omega.2015.05.015

Garcia-Muiña, F. E., González-Sánchez, R., Ferrari, A. M., Volpi, L., Pini, M., Siligardi, C., & SettembreBlundo, D. (2019). Identifying the equilibrium point between sustainability goals and circular economy practices in an Industry 4.0 manufacturing context using eco-design. Social Sciences, 8(8), 241.

Gualandris, J., & Kalchschmidt, M. (2014). Customer pressure and innovativeness: Their role in sustainable supply chain management. Journal of Purchasing and Supply Management, 20(2), 92-103. doi:10.1016/j.pursup.2014.03.001

Hall, J.R., Savas-Hall, S. and Shaw, E.H., 2022. A deductive approach to a systematic review of entrepreneurship literature. Management Review Quarterly, pp.1-30.

Hamam, M., Chinnici, G., Di Vita, G., Pappalardo, G., Pecorino, B., Maesano, G. and D’Amico, M., 2021. Circular economy models in agro-food systems: A review. *Sustainability*, *13*(6), p.3453.

Howard, M., Yan, X., Mustafee, N., Charnley, F., Böhm, S., & Pascucci, S. (2022). Going beyond waste reduction: Exploring tools and methods for circular economy adoption in small-medium enterprises. *Resources, Conservation and Recycling*, *182*, 106345. https://doi.org/10.1016/j.resconrec.2022.106345

Hazen B.T, D.A. Mollenkopf, Y. Wang 2017

Remanufacturing for the circular economy: an examination of consumer switching behaviour Bus. Strategy Environ., 26 (2017), pp. 451- 452

.

Hürlimann, C., 2019. Research Philosophy and Ethics. In Valuation of Renewable Energy Investments (pp. 111-126). Springer Gabler, Wiesbaden.

Iovino, F. and Tsitsianis, N., 2020. The methodology of the research. In Changes in European Energy Markets. Emerald Publishing Limited.

Irani, Z. and Sharif, A.M., 2018. Food security across the enterprise: a puzzle, problem or mess for a circular economy?. *Journal of Enterprise Information Management*.

Jurgilevich, A., Birge, T., Kentala-Lehtonen, J., Korhonen-Kurki, K., Pietikäinen, J., Saikku, L., & Schösler, H. (2016). Transition towards circular economy in the food system. Sustainability, 8(1), 69. https://doi. org/10.3390/su8010069

Kanwal N, Awan U (2021). Role of Design Thinking and Biomimicry in Leveraging Sustainable Innovation. In Leal Filho W, Azul AM, Brandli L, Lange Salvia A, Wall T (Eds.), Industry, Innovation and Infrastructure (pp. 1–12). Springer International Publishing. <https://doi.org/10.1007/978-3-319-71059-4_86-1>

Kagermann, H. Wahlster, W. Helbig J (2013) Recommendations for Implementing the Strategic Initiative INDUSTRIE 4.0 (2013) Final report of the Industry 4.0

Kayikci, Y., Kazancoglu, Y., Gozacan-Chase, N., & Lafci, C. (2022). Analyzing the drivers of smart sustainable circular supply chain for sustainable development goals through stakeholder theory. Business Strategy and the Environment. <https://doi.org/10.1002/bse.3087>

Kim, C.S. and Kim, K.R., 2016. A case study comparing textile recycling systems of Korea and the UK to promote sustainability. *Journal of Textile and Apparel, Technology and Management*, *10*(1).

Kiran. E.U, Trzcinski.A.P W.J. Ng, Y. Liu 2014 Bioconversion of food waste to energy: a review Fuel, 134 pp. 389-391

 Krishnan R, Renu Agarwal, Christopher Bajada, K. Arshinder,

Redesigning a food supply chain for environmental sustainability – An analysis of resource use and recovery,Journal of CleanerProduction,Volume 242,2020,118374,ISSN 0959-6526,https://doi.org/10.1016/j.jclepro.2019.118374

Kumar, M., Raut, R. D., Sharma, M., Choubey, V. K., & Paul, S. K. 2022. Enablers for resilience and pandemic preparedness in food supply chain. Operation Management Research. https://doi.org/10.1007/ s12063-022-00272-w

Kumar, P., Singh, R. K., & Kumar, V. (2021). Managing supply chains for sustainable operations in the era of industry 4.0 and circular economy: Analysis of barriers. Resources, Conservation and Recycling, 164(2021), 105215. <https://doi.org/10.1016/j.resconrec.2020.105215>

Lehtokunnas, T., Mattila, M., Närvänen, E., & Mesiranta, N. 2020. Towards a circular economy in food consumption: Food waste reduction practices as ethical work. Journal of Consumer Culture, 1469540520926252.

Liu, Y., Wood, L. C., Venkatesh, V. G., Zhang, A., & Farooque, M. 2021. Barriers to sustainable food consumption and production in China: A fuzzy DEMATEL analysis from a circular economy perspective. Sustainable Production and Consumption, 28, 1114–1129. https://doi.org/10. 1016/j.spc.2021.07.028

Maab O. and Grundmann, P., 2018. Governing transactions and interdependences between linked value chains in a circular economy: The case of wastewater reuse in Braunschweig (Germany). *Sustainability*, *10*(4), p.1125

Mangla, S. K., Luthra, S., Rich, N., Kumar, D., Rana, N. P., & Dwivedi, Y. K. 2018. Enablers to implement sustainable initiatives in Agri-food supply chains. International Journal of Production Economics, 203(2018), 379–393.

Mauthner, N.S., 2020. Research philosophies and why they matter. In How to Keep your Doctorate on Track. Edward Elgar Publishing.

Meherishi, L., Narayana, S. A., & Ranjani, K. S. 2019. Sustainable packaging for supply chain management in the circular economy: A review. Journal of Cleaner Production, 237(2019), 117582. https://doi.org/10. 1016/j.jclepro.2019.07.057

Mello, P.A., 2022. Qualitative comparative analysis: An introduction to research design and application. Georgetown University Press.

Merriam, S. B., & Tisdell, E. J. (2016). Qualitative research: A guide to design and implementation (4th ed.). San Francisco, CA: Jossey-Bass

Mogale, D. G., Kumar, S. K., & Tiwari, M. K. (2020). Green food supply chain design considering risk and post-harvest losses: A case study. Annals of Operations Research, 295(1), 257–284. https://doi.org/10. 1007/s10479-020-03664-y

Moon, K., Blackman, D.A., Adams, V.M., Colvin, R.M., Davila, F., Evans, M.C., Januchowski‐Hartley, S.R., Bennett, N.J., Dickinson, H., Sandbrook, C. and Sherren, K., 2019. Expanding the role of social science in conservation through an engagement with philosophy, methodology, and methods. Methods in Ecology and Evolution, 10(3), pp.294-302.

Mourad, M. (2016). Recycling, recovering and preventing “food waste”: Competing solutions for food systems sustainability in the United States and France. Journal of Cleaner Production, 126(2016), 461–477. <https://doi.org/10.1016/j.jclepro.2016.03.084>

Nanna, G.K.H., 2022. Challenges in Using Online Data Collection for Quantitative Survey Research.

Nasir, M. H. A., Genovese, A., Acquaye, A. A., Koh, S. C. L., & Yamoah, F. 2017. Comparing linear and circular supply chains: A case study from the construction industry. International Journal of Production Economics, 183(2017), 443–457. https://doi.org/10.1016/ j.ijpe.2016.06.008

Nawaz, A., 2018. Challenges Faced by Women Entrepreneurs in Pakistan: A Qualitative Study. Management and Organizational Studies, 5(2), pp.13-26.

Opie, C., 2019. Research approaches. Getting Started in Your Educational Research: Design, Data Production and Analysis, 137.

Pagell, M., & Shevchenko, A. (2014). Why research in sustainable supply chain management should have no future. Journal of Supply Chain Management, 50(1), 44-55. doi:10.1111/jscm.12037

Pandey, P. and Pandey, M.M., 2021. Research methodology tools and techniques. Bridge Center.

Papargyropoulou, E., Lozano, R., Steinberger, J. K., Wright, N., & bin Ujang, Z. (2014). The food waste hierarchy as a framework for the management of food surplus and food waste. Journal of Cleaner Production, 76(2014), 106–115. https://doi.org/10.1016/j.jclepro.2014. 04.020

Patton, M. Q. (2015). Qualitative research & evaluation methods: Integrating theory and practice (4th ed.). Thousand Oaks, CA: Sage.

Principato, L., Ruini, L., Guidi, M., & Secondi, L. 2019. Adopting the circular economy approach on food loss and waste: The case of Italian pasta production. Resources, Conservation and Recycling, 144(2019), 82–89. <https://doi.org/10.1016/j.resconrec.2019.01.025>

Queirós, A., Faria, D. and Almeida, F., 2017. Strengths and limitations of qualitative and quantitative research methods. *European journal of education studies*.

Radhakrishnan S (2016) Environmental footprints of packaging. In: Muthu SS (ed) Environmental footprints of packaging. Environmental footprints and eco-design of products and processes. Springer, Berlin, pp 165- 169

Rathore, P,Kota. S, Chakrabarti, A (2011) Sustainability through remanufacturing in India : a case study on mobile handsets J. Clean. Prod., 19 (2011), p. 1709

Ravitch, S.M. and Riggan, M., 2016. *Reason & rigor: How conceptual frameworks guide research*. Sage Publications.

Ravitch, S. M., & Carl, N. M. (2016). Qualitative research: Bridging the conceptual, theoretical, and methodological. Thousand Oaks, CA: Sage.

Reefke, H., & Sundaram, D. (2017). Key themes and research opportunities in sustainable supply chain management: Identification and evaluation. Omega, 66, 195-211. doi:10.1016/j.omega.2016.02.003

Riger, S. and Sigurvinsdottir, R.A.N.N.V.E.I.G., 2016. Thematic analysis. Handbook of methodological approaches to community-based research: Qualitative, quantitative, and mixed methods, pp.33-41.

Ripplesnigeria, 2021. *Ripple Nigeria.* [Online]
Available at: <https://www.ripplesnigeria.com/un-report-ranks-food-wastage-by-nigerians-as-highest-in-africa/> Accesed 6th of Nov 2022.

Rosen MA, Kishawy HA. Sustainable Manufacturing and Design: Concepts, Practices and Needs. Sustainability. 2012; 4(2):154-174. https://doi.org/10.3390/su4020154

Rubin, H. J., & Rubin, I. S. (2012). Qualitative interviewing: The art of hearing data (3rd ed.). Thousand Oaks, CA: Sage

Saunders, M., Lewis, P. & Thornhill, A. (2012) “Research Methods for Business Students” 6th edition, Pearson Education Limited

[Sharma, Y.K.](https://www.emerald.com/insight/search?q=Yogesh%20Kumar%20Sharma), [Mangla, S.K.](https://www.emerald.com/insight/search?q=Sachin%20Kumar%20Mangla), [Patil, P.P.](https://www.emerald.com/insight/search?q=Pravin%20P.%20Patil) and [Liu, S.](https://www.emerald.com/insight/search?q=Shaofeng%20Liu) (2019), "When challenges impede the process: For circular economy-driven sustainability practices in food supply chain", [*Management Decision*](https://www.emerald.com/insight/publication/issn/0025-1747), Vol. 57 No. 4, pp. 995-101.

Smith, P, Martino, D, Cai, Z et al. . (2007) Agriculture. In Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, pp. 498–550 [Metz, B, Davidson, OR, Bosch, PR, Dave, R, Meyer, LA, editors]. New York, NY: Cambridge University Press

Singh, D., SBPPSE, A. and Gate, K., 2019. Understanding philosophical underpinnings of research with respect to various paradigms: Perspective of a research scholar. Institute of Management, NIRMA University.

Steinhilper. R (2001) Recent trends and benefits of remanufacturing: from closed loop businesses to synergetic networks Proceedings - 2nd International Symposium on Environmentally Conscious Design and Inverse Manufacturing (2001), p.481 10.1109/ECODIM.2001.992404

Suhartini, S., Rohma, N.A., Elviliana et al. Food waste to bioenergy: current status and role in future circular economies in Indonesia. Energ. Ecol. Environ. 7, 297–339 (2022). https://doi.org/10.1007/s40974-022-00248-3

Taghavi, E., Fallahpour, A., Wong, K.Y. and Hoseini, S.A., 2021. Identifying and prioritizing the effective factors in the implementation of green supply chain management in the construction industry. *Sustainable Operations and Computers*, *2*, pp.97- 100

Thomas, D. R. (2016). A General Inductive Approach for Analyzing Qualitative Evaluation Data. *American Journal of Evaluation*. https://doi.org/10.1177/1098214005283748

Tidy, M., Wang, X., & Hall, M. (2016). The role of Supplier Relationship Management in reducing Greenhouse Gas emissions from food supply chains: supplier engagement in the UK supermarket sector. *Journal of Cleaner Production*, *112*, 3294-3305. https://doi.org/10.1016

Toma, J. D. (2011). Approaching rigor in applied qualitative research. In C. F. Conrad & R. C. Serlin (Eds.), The SAGE handbook for research in education: Pursuing ideas as the keystone of exemplary inquiry (2nd ed., pp. 405–423). Thousand Oaks, CA: Sag

Turner, D. W. (2010). Qualitative interview design: A practical guide for novice investigators. Qualitative Report, 15(3), 754–760. Retrieved from <http://nsuworks.nova.edu/tqr>

UNEP. (2021). UNEP Food Waste Index Report 2021. Retrieved January 20, 2022, from https://www.unep.org/resources/report/unep-food waste-index-report-2021

USITC 2012, Remanufactured Goods: an Overview of the U.S. And Global In- dustries, Markets and Trade United States International Trade Commission publication (2012)

USEPA, 2022. *United State Environmental Protection Agency.* [Online]
Available at: [https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/containers-and-packaging-product-specific date accessed 1-11-2022](https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/containers-and-packaging-product-specific%20date%20accessed%201-11-2022)

Vaez.E , Zilouei. H (2020) Towards the development of biofuel production from paper mill effluent Renew. Energy, 146 (2020), pp. 1408-1415

Vilariño, M. V., Franco, C., & Quarrington, C. 2017. Food loss and waste reduction as an integral part of a circular economy. Frontiers in Environmental Science, 5, 21. <https://doi.org/10.3389/fenvs.2017.00021>

Wang. Y, J.R. Huscroft, B.T. Hazen, M. Zhang 2016 Green information, green certification and consumer perceptions of remanufactured automobile parts Resour. Conserv. Recycle. (2016),

Weber, R.P., 1990. Basic content analysis Sage university papers series. *Quantitative applications in the social sciences Retrieved from WorldCat database Retrieved from http://catdir.loc.gov/catdir/enhancements/fy0655/90061019-d. html*

World Economic Forum (2016) The New Plastics Economy Rethinking the future of plastics. World Economic Forum,Cologny, pp1– 3 <https://doi.org/10.1103/Physrevb.74.035409>

[Wilson, M.](https://www.emerald.com/insight/search?q=Matthew%20Wilson), [Paschen, J.](https://www.emerald.com/insight/search?q=Jeannette%20Paschen) and [Pitt, L.](https://www.emerald.com/insight/search?q=Leyland%20Pitt) (2022), "The circular economy meets artificial intelligence (AI): understandin the opportunities of AI for reverse logistics", [*Management of Environmental Quality*](https://www.emerald.com/insight/publication/issn/1477-7835), Vol. 33 No. 1, pp. 9-25

Xu, Y . Lu, Y. L. Zheng, Z. Wang, X. Dai,J. Hazard. Mater. (2019),

Perspective on enhancing the anaerobic digestion of waste activated sludge

 p. 121847, 10.1016/j.jhazmat.2019.121847

Yin, R. K. (2016). Qualitative research from start to finish (2nd ed.). New York, NY: Guilford.

Yoong, L.S., Bashir, M.J. and Wei, L.J., 2021. Food Waste Management Practice in Malaysia and Its Potential Contribution to the Circular Economy. In *Handbook of Solid Waste Management: Sustainability through Circular Economy* (pp. 1-28). Singapore: Springer Singapore

Zhang, Y., Liu, Y., Jiong, Z., Zhang, X., Li, B., & Chen, E. (2021). Development and assessment of blockchain-IoT-based traceability system for frozen aquatic product. Journal of Food Process Engineering, e13669. <https://doi.org/10.1111/jfpe.13669>

**Appendix 1** Ethics form Approval (see Attached)

Date: 29th Oct 2022

Dear Chinedu Onwuachu

Following a review of your ethical application for your project titled ***(Investigating the challenges and opportunities of adopting circular economy practices in designing sustainable food supply chain in Nigeria)*** *on* LNDN11133, I am pleased to grant you ethics approval for Business Research Project.

Yours sincerely

Md Mostain Belal



(**Supervisor Name and signature**)

Date: 29/10/2022

A**ppendix 2** Research question and Interview question

|  |  |
| --- | --- |
|  **RESEARCH QUESTION**  |  **INTERVIEW QUESTION**  |
| To explore the significance of sustainable food supply chain design in Nigeria  | Can you explain the importance of considering sustainability practices within your operations?  What effects do you think sustainable practices operations will have on the environment, society, and the economy?1. Can you explain the key environmental practice you have adopted in your organization?

 (3.1)What are the challenges faced while adopting these practices? |
| To investigate the key challenges of adopting circular economy practices in designing a sustainable food supply chain in Nigeria | 1. Does your organization recycle or redesign products? If so, what difficulties does this procedure present for your operations?
2. Does your organization have reserve logistics in place, and how does it operate?

 (2.1) Can you describe the difficulties your organization is having putting these strategies into practice?(3) Can you explain the process in your organization that derives value from waste and product design, and what challenges arise while implementing it?(4) Can you describe the operation procedure for recycling, reusing, and remanufacturing in your organization? Do these procedures fall under any regulations?(5) What green practices has your organization adopted? (5.1) Can you describe the difficulties in putting these principles into practice? |
| To explore key opportunities for adopting circular economy practices in designing a sustainable food supply chain in Nigeria.  | (1) What economic, social, and environmental benefits can you expect from implementing green practices in your organization’s processes?(2) What are the social and environmental advantages of recycling and reusing products?(3)Could you explain how lessening the use of raw materials will enable resource recirculation?(4) Can you describe the economic and social advantages of implementing reverse logistics in your organization?(5) Can you explain how adopting sustainable practices would allow business professionals in the industry to take advantage of new commercial opportunities? |

**Appendix 3** Consent form Template

[CamScanne](https://digital-camscanner.onelink.me/P3GL/g26ffx3k)

[r](https://digital-camscanner.onelink.me/P3GL/g26ffx3k)

